Environmental Impact Assessment Scoping Document

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Preface

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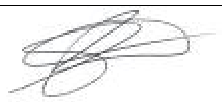
Approved	Director (DPME)	Simon De Pietro	Thursday, 12 December 2013	
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Figures:

Tables:

Acronyms:

ADCP	Acoustic Doppler Current Profiling
AFBI	Agri-food and Biosciences Institute
AfL	Agreement for Lease
AIS	Automatic Identification Systems
AONB	Area of Outstanding Natural Beauty
ASSI	Areas of Special Scientific Interest
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BIIS	British & Irish Ice Sheet (BIIS)
BS	British Standard
BTO	British Trust for Ornithology
BWEA	British Wind Energy Association
CCW	Countryside Commission for Wales
CD	Chart Datum
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CITES	Convention on the International Trade in Endangered Species of Wild Flora and Fauna
CIA	Cumulative Impact Assessment
COWRIE	Collaborative Offshore Wind Research into the Environment
CPS	Core Penetration Tests
CSEMP	Clean Seas Environmental Monitoring Programme
DARD	Department of Agriculture and Rural Development
DBE	DEME Blue Energy
DCAL	Department of Culture, Arts and Leisure
DDV	Drop Down Video
DECC	Department of Energy and Climate Change (a UK Government department)
DETI	Department of Enterprise, Trade and Investment
DIO	Defence Infrastructure Organisation
DoE MD	Department of the Environment – Marine Division
DoENI	Department of the Environment Northern Ireland
DPME	DP Marine Energy
DTI	Department of Trade and Industry
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
EMF	Electromagnetic Field
EMS	Environmental Management System
EPS	European Protected Species
ES	Environmental Statement
EU	European Union
FHTEP	Fair Head Tidal Energy Park
FEPA	Food and Environment Protection Act
FLO	Fisheries Liaison Officer
FSA	Food Standard Agency
GES	Good Environmental Status
GLA	General Lighthouse Authority
GSNI	Geological Survey Northern Ireland

HRA	Habitats Regulations Appraisal
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IBTSWG	International Bottom Trawl Survey Working Group
ICES	International Council for the Exploration of the Sea
ICPC	International Cable Protection Committee
IMO	International Maritime Organisation
INFO	National Federation of Fishermans Organisations
ISO	International Organisation for Standardisation
IUCN	International Union for the Conservation of Nature
IWDG	Irish Whale and Dolphin Group
JIBS	Joint Irish Bathymetric Survey
JNCC	Joint Nature Conservation Committee
KISCA	Kingfisher Cable Awareness Charts
km	kilometres
LAT	Lowest Astronomical Tide
LGM	Last Glacial Maximum
m	metres
m/s	Metres per second
MCA	Maritime and Coastguard Agency
MCT	Marine Current Turbines
MCZ	Marine Conservation Zones
MFSD	Marine Framework Strategy Directive
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MMOs	Marine Mammal Observers
MoD	Ministry of Defence (a UK Government Department)
MPA	Marine Protected Area
MPS	Marine Policy Statement
MSMR	Maritime Sites and Monuments Record
MW	Megawatts
NI	Northern Ireland
NIE	Northern Ireland Electricity
NIEA	Northern Ireland Environment Agency
NIFPO	Northern Ireland Fish Producers Organisation
NIMP	Northern Ireland Marine Plan
NM	Nautical Miles
NMMP	National Marine Monitoring Programme
NNR	National Nature Reserves
NSRA	Navigational Safety Risk Assessment
ODB	Ordnance Datum Belfast
OEM	Original Equipment Manufacturer
OFREG	Office for the Regulation of Electricity and Gas
OREI	Offshore Renewable Energy Installation
ORESAP	Offshore Renewable Energy Strategic Action Plan
OS	Ordnance Survey
PEXA	Practice and Exercise Areas
PHA	Preliminary Hazard Analysis

PMF	Priority Marine Feature
PMSS	Project Management Support Services Ltd
PSU	Public Services & Utilities
PSA	Particle size analysis and
RAM	Restricted in their Ability to Manoeuvre
RLG	Regional Locational Guidance
RNLI	Royal National Lifeboat Institution
ROV	Remotely Operated Vessel
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SAM	Scheduled Ancients Monuments
SEA	Strategic Environmental Assessment
SEI	Sustainable Energy Ireland
SLVIA	Seascape, Landscape and Visual Impact Assessment
SMRU	Sea Mammal Research Unit
SMP	Survey Monitoring Plan
SNH	Scottish Natural Heritage
SPA	Special Protection Areas
SRSL	SAMS Research Services Ltd
TEC	Tidal Energy Converters
TCE	The Crown Estate
TOC	Total Organic Carbon
THLS	Trinity House Lighthouse Service
TSS	Traffic Separation Scheme
UCD	University College Dublin
UKDEAL	UK Digital Energy Atlas Library
UKHO	United Kingdom Hydrographic Office
VHF	Very High Frequency
VTS	Vessel Traffic Services
WFD	Water Framework Directive
WHO	World Health Organisation
XLPE	Cross linked polyethylene
ZTV	Zone of Theoretical Visibility

Section 1: Introductory chapters

1. Introduction
2. Legislative & Policy Context
3. Site Selection Process and Alternatives Considered
4. The Environmental Impact Assessment, Environmental Statement & Consultation
5. Project Description

Photographer -
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1.0 Introduction

Fair Head Tidal Energy Park Ltd (FHTEP), a special purpose company set up by DP Marine Energy (DPME) and DEME Blue Energy (DBE), proposes to build a tidal energy development of up to 100MW installed capacity off Fair Head in North Antrim, Northern Ireland.

In October 2012 DPME and DBE were awarded an Agreement for Lease (AfL) from The Crown Estate (TCE) for an area of seabed of approximately 3km^2. This agreement includes exclusive rights to evaluate, consent and ultimately develop a 100MW tidal energy project. If successful in obtaining the necessary consents and licences, it is anticipated that the initial deployment of devices could commence in 2017, (possibly sooner subject to grid availability) and the project would reach full commercial operation by the end of 2019.

1.1 Scope and Method Proposal

This document forms FHTEP's written request to:

(i) the Department of Environment, Marine Division (DoE MD) as the appropriate licensing authority for Northern Ireland under the Marine and Coastal Access Act 2009, for their opinion as to the information to be provided in the Environmental Statement (ES) for the tidal development and associated subsea cable(s), under Regulation 13 of the Marine Works (Environmental Impact Assessment) Regulations (Northern Ireland) 2007; and

(ii) the Department for Enterprise, Trade and Investment (DETI), as the Department in Northern Ireland responsible for consenting the construction of any new generating station requiring consent under the Electricity (Northern Ireland) Order 1992, for its opinion as to the information to be provided in the Environmental Statement (ES) for the tidal development and associated subsea cable(s), under Regulation 5 of The Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008

This document also informs DoE MD that FHTEP intends to make an application for the following consents and licences:

- A Marine Licence under Part 4 of the Marine and Coastal Access Act 2009 (DoENI 2009) for the placing of materials on the sea bed, the disposal of waste at sea and the use of certain chemicals. Under article 8 of the Marine Works (Environmental Impact Assessment) Regulations 2007 (amended 2011) any activity requiring a marine licence and that is considered likely to have significant effects on the environment must accompany the application with an Environmental Statement (ES);

- A Consent under Article 39 of the Electricity (Northern Ireland) Order 1992 from the Department Enterprise, Trade and Investment, (DETI) as amended by The Electricity Consents (Planning) (Northern Ireland) Order (2006) for the construction and operation of the Tidal Array, with a capacity exceeding 1MW.

The electrical connection beyond the export cables landing point at mean high water springs (MHWS) on the Antrim coast is not considered in this scoping document and will be the subject of a separate scoping document and application for consent under Section 40 of the Electricity (Northern Ireland) Order 1992 from DETI for the associated overhead lines from the land based substation.

Outline details of these elements are included within this scoping document for information only to add context to the project. Therefore, the following elements are not included in the scoping document:

- Any onshore cabling beyond high water mark;
- Any metering or control room buildings;
- Electrical substations; and
- Any operational support or maintenance facilities.

The Planning Service of Northern Ireland has no jurisdiction over off-shore renewable proposals. This is the responsibility of the Department of Enterprise, Trade and Investment, On-shore ancillary development to serve off-shore renewable proposals (e.g. power lines or substations) will be dealt with by Planning Service. A provision for Deemed Planning Permission under Article 2 of The Electricity Consents (Planning) (Northern Ireland) Order (2006) for the onshore parts of a project, such as the control building, external electrical components, onshore cable routes and associated infrastructure to be considered under the provisions of the Order. This Order amended Schedule 8 of the Electricity Order (Northern Ireland) but is not currently operational thus the onshore parts of the development will require to be submitted under the normal planning process of the Planning (Northern Ireland) Order (1991).

TCE own the foreshore and seabed from High Water to the 12 nautical mile limit.

Central to the project feasibility will be an assessment of the environmental effects likely to arise during construction, operation and decommissioning of the tidal array and identification of suitable mitigation measures where appropriate. By incorporating such measures in the design process, potential impacts can be reduced.

The purpose of this scoping document is also to provide a focus for the ES by identifying the key issues of relevance and to outline the scope and approach that will be adopted. It is anticipated that various organisations will have the opportunity to submit comments and to offer information relevant to the preparation of the ES.

The ES will be structured to provide a description of the proposed development and the existing environment, an assessment of the impacts of the development and the measures to mitigate adverse impacts.

2.0 Policy, Legislation and Guidance

2.1 Policy Context

Renewable energy sources are natural energy sources such as sunlight, wind, waves and tides, which are continuously replenished. Of these, marine renewables (wave and tidal) energy has the potential to play a vital part in the future energy supply. Within the marine industry wave and tidal prototype devices are currently being developed and tested in the field with a medium term view for the deployment of arrays of such devices at suitable locations around the coastline of the United Kingdom and Ireland. Wave and tidal offers benefits in terms of electricity generation that is free from emissions of carbon dioxide (the main 'greenhouse gases associated with global warming) and other pollutants.

In response to growing concerns on climate change related impacts the EU Commission implemented a new Directive 2009/28/EC "On the Promotion of the Use of Energy from Renewable Sources and Amending and Subsequently Repealing Directives 2001/77/EC and 2003/30/EC" established a common framework for the production and promotion of energy from renewable sources. Each Member State has adopted a target calculated according to the share of energy from renewable sources in its gross final consumption for 2020. This target is in line with the overall '20-20-20' goal for the Community.

Together with its legal obligation under Kyoto, targets committed to under its EU obligations and the conclusions from Stern Review on the Economics of Climate Change, the need to tackle climate change has considerable implications for the UK. Energy production has declined since 1999, to the extent that the UK became a net importer of energy in 2004. In 2009, 26.7% of the UK's energy needs were imported. This reliance on imported energy combined with the scheduled loss of 25% of our existing energy generating capacity by 2018 through power station closure is considered to be an unsustainable energy model.

In 2009, the UK Government released the Low Carbon Transition Plan White Paper which plots how the UK will meet its cut in emissions targets on 1990 levels by 2020. Developing a low carbon energy sector for the longer term can deliver both increased energy security for the UK and ensure that it meets international targets for the reduction of greenhouse gas emissions.

The value of marine renewable energy to the UK economy has also been identified in the UK Marine Industries Strategic Framework (BIS 2010). This identifies the marine renewable sector as an area for future potential growth with wave and tidal energy forecast to attract up to £4 Billion in investment per annum to 2050.

The Northern Ireland Executive in conjunction with the UK government and EU Renewable Policy, as part of their strategy to reduce greenhouse gases and tackle global warming, has now placed a national obligation on all electricity suppliers to provide 40% of their electricity from renewable sources by 2020. An interim 2012 target of 12% was met, mostly by onshore wind.

To progress the 40% target DETI appointed AECOM and Metoc to undertake a Strategic Environment Assessment (SEA) of the potential effects that the development of offshore wind and marine renewable energy would have on the coastline of Northern Ireland and territorial (12nm limit) marine environment. The results of the SEA have been used by DETI to inform the development of its offshore renewable energy Strategic Action Plan (ORESAP), which has been developed in parallel to this SEA. An aim of the ORESAP is that 300MW is generated from tidal resources in Northern Ireland by 2020 the potential for offshore wind to contribute an additional 600MW.

2.2 Northern Ireland Policy and Strategy

2.2.1 Northern Ireland Executive Policy and Aspirations

The Northern Ireland Executive is demonstrating an enviable commitment to the concept of sustainable development and the role that renewable energy resources will have to play. Several strategies and policies have been released since 2005 which demonstrate such a commitment.

Earlier this year Energy Minister Arlene Foster proposed new legislation for offshore renewables commenting that:

“The development of offshore renewable energy is an excellent opportunity for Northern Ireland in terms of security and diversity of supply, as well as climate change mitigation. It also contributes to the Executive’s 2020 targets and brings significant business supply chain opportunities for local companies.

“I recently welcomed the signing of agreements for a 600MW offshore wind project and 200MW of tidal developments in Northern Ireland’s first offshore renewable energy Leasing Round. It is important now to ensure that the appropriate regimes are in place to facilitate the timely and sustainable development of these projects.”

2.2.2 A Sustainable Development Strategy for Northern Ireland 2010.

With reference to Chapter 4 Principles, Priorities & Strategic Objectives, Priority Areas for Action include under item 5:

“ ... We must promote renewable energy, protecting ourselves from the volatility of international markets and the implications for security of supply. ..”

2.2.3 Strategic Energy Framework for Northern Ireland 2010

With reference to Chapter 4: Goal 3 Enhancing Sustainability, Offshore Renewables, it is stated that:

“DETI believes that offshore renewable electricity can make a significant contribution to the generation mix in Northern Ireland to 2020 and beyond. On foot of the Strategic Environmental Assessment (SEA) of our plans to optimise the sustainable development of offshore renewable electricity in Northern Ireland waters,”

2.2.4 Offshore Renewable Energy Strategic Action Plan 2012-2020

Under Chapter 4: Aim and Key Actions, the overall aim of the ORESAP 2012 – 2020 is:

"to optimise the amount of renewable electricity sustainably generated from offshore wind and marine renewable resources in Northern Ireland's waters in order to enhance diversity and security of supply, reduce carbon emissions, contribute to the 40% renewable electricity target by 2020 and beyond and develop business and employment opportunities for NI companies. The associated development opportunity is for up to 900 MW of offshore wind and 300 MW from tidal resources in Northern Ireland waters by 2020."

2.2.5 Strategic Environmental Assessment (SEA) (2009) and Regional Locational Guidance (RLG) for Offshore Renewable Energy Developments in NI Waters (2011).

One of the key objectives of the SEA and RLG was to evaluate the feasibility of offshore renewables contributing towards the Strategic Energy Framework proposal of 40% of electricity to come from renewable source by 2020. The proposed target based on the SEA findings was to develop 600MW of offshore wind and 300MW from tidal resources by 2020.

2.3 Legislative Context

2.3.1 Electricity Order 1992

Under Articles 8 to 13 of the Electricity (Northern Ireland) Order 1992 (5.1. 1992/231 (N.I. l)) ("the Parent Order") a Generation Licence is needed to cover the production of electricity and a supply licence to cover its provision to premises unless one or other of certain exemptions applies.

Under Article 39 of the Electricity Order 1992 ('the Order') and subsequent Electricity (Offshore Wind and Water Driven Generating Stations) Permitted Capacity Order Northern Ireland 2008, consent is required from the Northern Ireland DETI for the construction, extension and operation of a water driven generating station with a capacity of 1MW or over.

The capacity of the proposed tidal array will be up to approximately 100MW, therefore consent will be required under Article 39 of the Order.

Consent under Article 40 of the Electricity Order 1992 from the DETI for the associated overhead lines from the land based substation. Depending on eventual capacity and routing of these lines their installation may be consented and constructed by NIE.

Deemed Planning Permission under Article 2 of The Electricity Consents (Planning) (Northern Ireland) Order 2006 for the onshore parts of the project such as the control building, external electrical components, onshore cable routes and associated infrastructure to be considered under the provisions of the this Article. This order amended Schedule 8 of the Electricity Order 1992 from DETI. This option is not currently operational and the therefore the onshore elements of the development will be submitted as a separate application under the normal planning process of the Planning (Northern Ireland) Order 1991.

2.3.2 Marine and Coastal Access Act 2009

The UK Government's Marine and Coastal Access Act 2009 gained Royal Assent on 12 November 2009. This Act will ensure clean healthy, safe, productive and biologically diverse oceans and seas, by putting in place better systems for delivering sustainable development of marine and coastal environment. The DoE MD is the appropriate licensing and enforcement authority for devolved matters within the Northern Ireland 'inshore region' as defined by Section 322 of the 2009 Act.

A Marine Licence under Part 4 of the Marine and Coastal Access Act 2009 for the placing of materials on the sea bed, the disposal of waste at sea and the use of certain chemicals. Under Article 8 of the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended in 2011) any activity requiring a marine licence and that is considered likely to have significant effects on the environment must submit accompany the application with an ES. It is understood that the ES, the subject of this scoping document, will be also used for the Marine licence application.

Other key elements of the UK Marine and Coastal Access Act 2009 (and associated regulations and orders in 2011) include:

- Marine Licensing;
- Marine Nature Conservation;
- Fisheries Management and Marine Enforcement;
- Migratory and Freshwater Fisheries;
- Coastal Access; and
- Coastal and Estuary Management.

2.3.3 Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008

The Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008 ('the EIA Regulations') implement Council Directive 85/337/EEC as amended by Council Directive 97/11/EC on the assessment of the effects of certain public and private projects on the environment, insofar as it relates to applications for consent to construct, extend or operate an offshore power station under Article 39 of the Order.

Under these Regulations, Article 39 developments that are considered likely to have significant effects on the environment must be subject to an Environmental Impact Assessment (EIA) and an ES submitted with the Article 39 application.

Schedule 1 of the Regulations lists those developments for which EIA is mandatory, whilst Schedule 2 describes projects for which the need for EIA is judged by DETI on a case-by-case basis through a screening process. Schedule 3 describes the criteria to be used by DETI to determine if a development is 'EIA development'.

Where an EIA is required, environmental information must be provided by the developer in an Environmental Statement. Schedule 4 specifies the information that must or may be provided in such a Statement.

The Regulations prohibit DETI from granting consent for an EIA development without taking into account an ES, together with any associated environmental information.

The proposed tidal array is a Schedule 2 development: "(1) a generating station, the construction of which (or the operation of which) will require an Article 39 consent but which is not a development falling within Schedule 1." If therefore it is likely to have significant environmental effects because of factors such as its nature, size or location, it is 'EIA development', and a formal EIA is required. FHTEP independently propose that the tidal development should be subject to EIA.

2.3.3.1 Obtaining a Scoping Opinion (Regulation 5)

Under Regulation 5, the developer of an EIA development may ask the DETI, before submitting an application for an Article 39 consent under the Act, to state in writing their opinion as to the information to be provided in the Environmental Statement (i.e. to provide a 'Scoping Opinion').

The request for a scoping opinion must be in writing and should include basic information on the proposed development as set out below:

a) a plan sufficient to identify the site which is the subject of the proposed development;
b) a brief description of the nature and purpose of the proposed development and its possible effects on the environment; and
c) such further information or representations as the person making the request may wish to provide or make.

This information is presented in the following sections.

Once they have all the information they require, DETI are required to consult and obtain the views of the consultative bodies (the District Council of the area in which the development is planned and other authorities as appear to it likely to be concerned by the proposed development by reason of their specific environmental responsibilities)

When DoE MD issues a scoping opinion, they must state what information should be included in the ES, giving their reasons why. The Regulations also require the Department make available to the public their scoping opinion. The findings of this scoping document in conjunction with the scoping opinion received from the Department and other consultees will be used to inform the EIA.

In terms of other relevant EIA legislation it is understood that the regulatory requirements in regard to the Marine Works (Environmental Impact Assessment) Regulations 2007 and Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999, will be encompassed within the requirements of The Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008.

2.3.3.2 Provision of Information by Consultative Bodies (Regulation 7)

Under Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008 and the Marine Works (Environmental Impact Assessment) Regulations (Northern Ireland) 2007, public bodies must make environmental information available to any person who requests it. These Regulations are pertinent where a developer is preparing an ES for an EIA development.

Regulation 7 of the EIA Regulations provides for the developer to acquire from public bodies any environmental information which they hold which will assist in the preparation of the ES.

When the developer notifies DETI under Regulation 6 of Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008, that he intends to provide an ES with the application, the Department will notify the Consultative Bodies and other relevant environmental organisations and ask them to make the information available. The developer will be told who these organisations are, together with their addresses.

2.3.3.3 The Environmental Impact Assessment Process

Environmental Impact Assessment (EIA) is a process which identifies the potential environmental effects of a development and then seeks to avoid, reduce or offset any adverse effects through 'mitigation measures'. EIA follows a series of stages:

Pre-scoping

- Site selection and project initiation;
- Screening – is an EIA required?
- Pre-application discussions;

Scoping – consultation on proposed scope and methodology;

- Environmental baseline studies – establish what is there;
- Assessment of effects – determine the potential effects;
- Mitigation – modify proposals to incorporate mitigation measures and re-assess residual effects;
- Preparation of Environmental Statement;
- Submission of Article 39 Application with Environmental Statement;
- Consideration of application and environmental information by Northern Ireland Executive and consultees;
- Decision to refuse or grant consent (with or without conditions); and
- Implementation and monitoring.

In reality the EIA process is both iterative and cyclic, and runs in tandem with project design. As potential effects are identified, the design of the project, e.g. the layout of the tidal array will be adjusted and mitigation measures proposed. Consultation, a vital component of the EIA process, continues throughout each stage and contributes both to the identification of potential effects and mitigation measures.

The EIA process therefore provides the opportunity to develop projects, for which the environmental effects have effectively been removed or minimised. In many cases significant effects on for example ecology, birds, mammals and noise can be prevented through sensitive design and selection. Others, for example the effects of construction, can be effectively managed through the adoption of best practice.

At this early scoping stage however it is important to identify all the 'potential' effects so that a rigorous assessment process, with input from independent experts, is followed based on sound objective evidence. The potential effects of the proposed tidal array are therefore described in Section 3 (Biological Environment and Section 4 (Human Environment) of this scoping document. The main potential significant effects of the tidal array are then stated on which the ES should focus. Those effects that are considered to be non-significant issues are also stated and a justification provided for those effects that have been effectively scoped out of the ES.

2.3.4 Marine Planning

In terms of marine planning two of the main deliverables include the introduction of a Marine Policy Statement (MPS) (DEFRA 2011) and the designation of regional marine plans.

The Northern Ireland Marine Plan (NIMP) is a marine plan being prepared by the DOE MD, under Article 51 of the Marine and Coastal Access Act 2009 and equivalent provisions of the Marine Act 2013. The NIMP aims to achieve better management of the marine resources in a sustainable way.

In March 2011, the UK Government and the Devolved Administrations published the Marine Policy Statement (MPS) (DEFRA 2011). The MPS is a UK-wide document that applies to the whole of the UK's marine waters. It will set out the key strategic priorities for the UK marine area and will be developed in such a way as to be a tangible product against which sustainable licensing decisions will be able to be taken throughout the UK until such times as marine plans are in place.

The Marine Act (Northern Ireland) 2013 (DoENI 2013) received Royal assent on 17 September 2013. The Act sets out a new framework for Northern Ireland's seas based on: a system of marine planning that will balance conservation, energy and resource needs; improved management for marine nature conservation and the streamlining of marine licensing for some electricity projects. The Marine Act applies to the Northern Ireland inshore region – this is the territorial sea out to twelve nautical miles.

2.3.5 Habitats Directive 1994

The Habitats Directive is the short name for 'Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora'. This 'Habitats Directive' is transposed into law through the Conservation (Natural Habitats, & c.) Regulations (Northern Ireland) 1995. These Regulations are commonly referred to as the 'Habitats Regulations'. Amongst other measures, the Habitats Regulations afford protection to certain species identified in the Habitats Directive, including those requiring strict protection (European Protected Species).

Consideration will be made with regards to the potential requirement for an Appropriate Assessment (AA) and Environmental Protected Species licences.

2.3.5.1 Habitats Regulations Appraisal (HRA)

HRA is a separate process from EIA. The HRA process relates specifically to the consideration of effects on Natura sites designated for their importance for European protected habitats and species. The process considers the potential effects of the development on internationally important habitats and/or species for which the sites are or will be designated. The assessment includes consideration of direct and indirect effects on these interests and must also consider cumulative effects from other proposed plans or projects.

Appropriate Assessment (AA) is one stage of this process. A competent authority shall make an Appropriate Assessment of the implications for a site in view of that site's conservation objectives, before deciding to undertake or give any consent, permission or other authorisation for, a plan or project which:

- Is likely to have a significant effect on a European site in the UK (either alone or in combination with other plans or projects); and
- Is not directly connected with or necessary to the management of the site.

The AA must ascertain that the proposed project will not adversely affect the integrity of the site. In all other circumstances, including cases where there is doubt about the absence of adverse effects, the proposal may not proceed unless there are no alternative solutions and imperative reasons of over-riding public interest apply.

2.3.5.2 European Protected Species Licence (EPS)

Certain species are listed in Annex IV of the Habitats Directive as species of European Community interest and in need of strict protection. The protective measures required are outlined in Articles 12 to 16 of the Directive.

The associated regulations make it an offence to deliberately or recklessly capture, kill, injure, harass or disturb any such animal. It is also an offence to deliberately or recklessly obstruct access to a breeding site or resting place of any such animal, or otherwise to deny the animal use of the breeding site or resting place. In addition, it is an offence to disturb such an animal in a manner that is, or in circumstances which are, likely to significantly affect the local distribution or abundance of the species to which it belongs. For cetaceans (dolphins, porpoises and whales) only, there is a more general offence deliberately or recklessly to disturb these creatures. The damage or destruction of a breeding site or resting place of any EPS of animal is an offence of strict liability. An EPS Licence is required for any activity that might result in disturbance to an EPS.

2.3.6 Other Consents and Licenses

The requirements under The Energy Act 2004 for offshore installations to prepare decommissioning plans will also be considered.

2.3.7 Terrestrial Development Plans

The study area for the proposed tidal array lies within the Moyle District Council Area. Although the main components of the tidal array will be below the mean high water springs mark and thus outside the formal planning jurisdiction there will be a number of components onshore (such as the control building, electrical infrastructure, cable landfall) to which Planning Service of Northern Ireland policies will be directly relevant.

3.0 Rationale and Alternatives

3.1 Introduction

It is a requirement of the Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008, under Schedule 4 Part 2 and Schedule 3 of Marine Works (Environmental Impact Assessment) Regulations (Northern Ireland) 2007 that information to be included in an ES should include "An outline of the main alternatives studied by the applicant or appellant and an indication of the main reasons for his choice, taking into account the environmental effects."

This can be interpreted to mean not only alternative sites, but also alternative technologies. The EIA will consider alternative energy options, alternative technologies and alternative sites, and also describe the site selection process and the rationale for the proposed development.

3.2 Advantages of Tidal Energy

There are many different forms of renewable energy which can contribute to meeting the challenge of reducing our reliance on fossil fuels. Potentially all renewable energy solutions have a place and in respect of the choice of resource it is simply a question of which solution is appropriate for a given location or region.

The EIA will outline the various options including solar, wind and wave in particular.

3.3 Alternative Tidal Energy Development Sites

Based on tidal energy resource data presented in the Atlas of UK Marine Energy Resources (2008) there are a number of potential development areas with a significant tidal flow around the United Kingdom. Inevitably application of physical and environmental constraints reduces the potential development areas substantially especially when the tidal area would also be required to support a substantial development of several hundred MW.

The RLG figure 1.1 identified a number of tidal resource zones of which the Antrim Coast was one.

The EIA will consider a number of the alternatives available and outline the rationale behind the selection of the Fairhead site

3.4 Alternative Tidal Technologies - Selected Design Envelope and Effect on EIA

The rationale for the design envelope selection is driven by the objective of minimum technology risk, and is based on devices most likely to have the potential to perform, survive and be maintainable within the environment. Whilst there are a number of alternative tidal technology solutions being offered including closed rotor ducted turbines, and oscillating aerofoils the majority of device technologies and arguably all of those supported by major Original Equipment Manufacturers (OEMs) are horizontal axis open rotor machines. At the MW and multi MW scale this includes manufacturers such as Siemens MCT, Andritz Hammerfest, Alstom TGL, Voith Hydro, Kawasaki, and at the sub MW scale Tocardo, Schottel etc.

For the purposes of this scoping document the initial design envelope has therefore been structured around a horizontal axis open rotor turbine either seabed or gravity base mounted.

The design envelope has been chosen to provide a realistic outline of the device that might be employed. The key choices within this envelope which may affect the environmental impact of the device are listed below.

3.4.1 Rotor parameters and variables

The effect of different rotor parameters of diameter, number of blades, rotational speed, and height in water column will all be considered within the EIA process and the reason for the alternatives discussed.

3.4.2 Surface Piercing or Submerged Structure

There are significant and obvious advantages to the use of surface piercing (floating or seabed mounted) structures in which the structure provides a platform for access, and field maintenance. The differences between submerged and surface structures and their different effects on visual impacts and navigation in particular will be considered within the EIA and the rationale for the alternatives discussed.

3.4.3 Foundations

A number of alternative design foundation solutions are possible. The EIA will consider the potential foundation solutions including the use of drilled pin piling foundations, moored platform solutions and gravity base foundations. The advantages and disadvantages from both an engineering and ecological perspective will be discussed within the ES. Intrusive foundations for example may result in short term release of sediment, and high noise levels whilst gravity bases may induce larger changes to the seabed environment with greater degrees of scour over a longer period.

A detailed assessment of the potential impacts of the alternative solutions will be carried out as part of the EIA process.

4.0 Environmental Impact Assessment.

4.1 The EIA Process

4.1.1 Legislative Context

The Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008 ('the EIA Regulations') implement Council Directive 85/337/EEC as amended by Council Directive 97/11/EC on the assessment of the effects of certain public and private projects on the environment, insofar as it relates to applications for consent to construct, extend or operate an offshore power station under Article 39 of the Order.

Tidal developments fall under Schedule 2 Paragraph 1(a) of the regulations and therefore likely to have significant effects on the environment by virtue of factors such as its nature, size or location. It is classed as "EIA development" and FHTEP recognises the need to undertake an EIA without making a formal request to DoE MD for a determination as to whether this proposed development would or would not be an EIA development.

4.1.2 Scope

An extensive EIA will be undertaken to assess any potential environmental impacts from the proposed development. The assessment will include all phases including construction, operation and decommissioning. Potential effects including possible mitigation measures for minimising effects where appropriate will be assessed for the physical, biological and human environments.

The assessment of environmental impacts will be conducted in accordance with best practice. The following key stages will form the basis of the assessment process:

- Consultation with statutory and non–statutory bodies and relevant stakeholders;
- Establishing a robust baseline of the existing environment on and around the site;
- Assessment of the environmental impacts and establishing their significance
- (primarily the assessment of residual effects once mitigation has been adopted); and
- Formulation of mitigation measures to ameliorate the potential impacts of the proposed development that cannot be avoided practically through site design.

Following established best practice, it is intended that the development will evolve in an iterative manner with the assessment process, led mainly by the consideration of constraints that exist within and around the site (environmental, technical and economic). Once the preferred design is selected, this will form the basis of the impact assessment.

4.1.3 Consultation During the EIA Process

It is recognised that the development of tidal energy farms is a new process and inevitably there will be uncertainties as to the specific assessments required. As more experience is gained from demonstration projects or other development sites, and as more detailed technical information becomes available from candidate turbine manufacturers, it is possible that further assessment work will be required and therefore this scoping document must be considered a "live" document reflecting current status of knowledge.

It is essential that a clear understanding of details as they emerge is shared with relevant parties and in that respect FHTEP proposes to adopt an open EIA process with scheduled meetings/discussions with relevant bodies as the EIA develops.

Consultation with relevant authorities, organisations and stakeholders will be undertaken throughout the assessment and site design process, commencing with screening and scoping. The consultations will serve three main purposes:

- To establish a sufficiently robust environmental baseline of the development and its surroundings;
- To identify, early in the process, specific concerns and issues relating to the development in order that they can be discussed and appropriately accounted for in the design and assessment; and
- To ensure the appropriate involvement of the public and authorities in the assessment and design process.

Following the announcement that FHTEP were awarded AfL, DPME contacted the following statutory and non-statutory consultees in December 2012 (table 4.1), February 2013, April 2013 and October 2013 to introduce and provide an update on the project.

Agri-Food & Biosciences Institute	Geological Survey Northern Ireland	Rivers Agency
ANIFPO (Anglo Northern Ireland Fish Producers Organisation)	Glens Red Squirrel Group	RNLI Portrush
Aquaculture Initiative	HM Coastguard Coleraine (North Coast)	Royal Yachting Association NI
Aquaholics Dive School	Irish Surfing Association	RSPB Northern Ireland
Argyll & Bute Council	Irish Whale & Dolphin Society	Sea Mammal Research Unit
Ballintoy & Dist Community Dev. Assoc/ Ballintoy Community Information Portal	Joint Nature Conservation Committee	Seafood Industry Authority
Ballycastle Community Development Group	Larne Borough Council (Environmental Health)	Seasearch Northern Ireland
Ballycastle Harbour/Marina	Larne Harbour Authority	Seatons Marina
Bangor Marina	Londonderry Port and Harbour Commission	Sinn Fein East Antrim/ Friends - Special Need
Belfast Harbour Commissioners	Loughs Agency	Sustainable NI
Bushmills & District Community Association	M.A.G Marine	The Wildfowl and Wetlands Trust
Canoe Association NI	Marine Conservation Northern Ireland	Torr Head Harbour (Portaleen Harbour)
Causeway Coast and Glens Heritage Trust	Marine Scotland	Ulster Farmers Union
CEFAS	Maritime and Coastguard Agency	Ulster Wildlife Trust
Centre for Maritime Archaeology	Moyle District Council	WWF Northern Ireland
Coleraine Borough Council	Moyle Interconnector	Green Party
Coleraine Harbour	Moyle Sea Angling Club	MP for East Antrim DUP

Commissioners		
Coleraine Marina	National Trust	MP for North Antrim DUP
Commissioners of Irish Lights	NI Agent for The Crown Estate	MP for East Londonderry
Council for Nature Conservation and the Countryside	NI Environment Link	Ulster Unionist Party - North Antrim
Cushendall Sailing & Boating Club	North Coast Lobster Fisherman's Association	Traditional Unionist Voice - North Antrim
Cushendun & District Development Association	Northern Ireland Agricultural Producers Association	DUP - North Antrim
DARD Environmental Policy Division	Northern Ireland Environment Agency	Sinn Fein - North Antrim
Defence Estates	Northern Ireland Federation of Sub Aqua Clubs	Ulster Unionist Party - East Antrim
Department for Regional Development (Air and Seaports)	Northern Ireland Fire & Rescue Service	Alliance Party - East Antrim
Department for Regional Development (Roads) Northern Division	Northern Ireland Fish Producers Organisation (NIFPO)	Sinn Fein - East Antrim
Department of Agriculture & Rural Development (Fisheries Division)	Northern Ireland Fishery Harbour Authority	DUP - East Antrim
Department of Culture Arts & Leisure	Northern Ireland Scallop Fisherman's Association	DUP - East Londonderry
Department of Enterprise, Trade & Investment	Northern Ireland Tourist Board	Social Democratic & Labour Party - East Londonderry
Department of Environment - Marine Division	Northern Ireland Water	Independent - East Londonderry
Department of Environment - Planning Service	Rathlin Development and Community Association	Sinn Fein - East Londonderry
Department of Environmental Science	Red Bay Boats Ltd	Moyle District Council
Friends of the Earth Northern Ireland		

Table 4.1: List of Consultees

FHTEP intends to carry out community consultation based upon public exhibitions, meetings and circulars and would welcome comments on how the community and other stakeholders would prefer to be consulted.

A Local Community Consultation and PR Plan is being developed. Briefing information on the project has been provided to inform the local community and seek their views. The main objectives of the Communication Plan are:

- to ensure that the local community is kept fully informed, in timely fashion, of plans and developments. It is also important to ensure they understand that they have a say in how developments proceed, both through the statutory process and through consultation; and
- to keep the wider community informed of developments. This includes both the general public and local statutory bodies.

In additional, a project specific web site www.fairheadtidal.com has been set up to provide information on the project and its development.

4.1.4 Baseline Assessment

The environmental baseline of the site and its surroundings will be established for each environmental aspect under consideration. This will be achieved largely through consultations with relevant authorities and organisations, a desktop review of available data and literature generated from consultations, and detailed interpretation of specialist field surveys.

4.1.5 Assessment of Environmental Impacts and their Significance

Impacts can be assessed as positive, neutral or negative. Evaluation of the significant impacts is important. The significance determines the resources that should be applied in avoiding or mitigating an adverse impact or the actual value of a positive impact. Furthermore, the combined significance of the various mitigated impacts determines the overall environmental acceptability of a project.

Determining the significance of environmental impacts is one of the most contentious parts of the process, involving value judgements and personal expert interpretations about whether, and to what extent, a proposal is environmentally significant. Factors which influence the judgement include:

- the character, sensitivity and current use of the environment;
- the nature, magnitude and scale of the proposal
- the likely nature, magnitude and duration of the impact;
- the resilience/sensitivity of the affected environment;
- the confidence in the predicted impacts;
- the level of public concern and knowledge of the issue; and
- the potential for mitigation;

The assessment will also take into account the different environments encountered by the project where impacts may occur. These include three main areas:

- The tidal development site;
- The subsea cable route(s); and
- The onshore intertidal environment (landfall location);

Efforts will be made throughout the assessment to ensure that criteria and standards of significance are identified and documented and that the level of certainty of data is recorded. An explanation will be provided on the criteria that have been applied in each relevant section.

The assessment will evaluate all phases of the project including the construction, operational and decommissioning phases.

For all environmental aspects, the significance of residual impacts, i.e. those predicted once mitigation is taken account of, will form the basis of the assessment.

4.1.6 Development of Mitigation Measures

All measures proposed as mitigation for the development will be reported within the relevant sections of the ES. The mechanism by which these measures will be carried through and implemented on site will also be defined.

5.0 Project Description

5.1 Site Description

5.1.1 Location and Scale

The development area defined in the AfL is centred approximately 2km to the east of Fair Head off the north Antrim coast and lies around 1km at its nearest point to land. When fully developed, is expected to have an installed capacity of around 100MW.

The site, occupying an area of approximately 3km^2 is centred on latitude 55^0.231 and longitude -6^0.107 and is illustrated on Admiralty Chart 2724 Figure 5.1 and North Antrim map Figure 5.2. The boundary co-ordinates are as follows:

ID	Latitude	Longitude
1	55.221721	-6.082154
2	55.222640	-6.092974
3	55.221573	-6.094403
4	5.217691	-6.089979
5	55.218010	-6.090850
6	55.230930	-6.130190
7	55.237900	-6.117200
8	55.234400	-6.095980
9	55.234350	-6.095980
10	55.223820	-6.079350

WGS1984 decimal degrees

Table 5.1: Fair Head Development Site Coordinates

5.1.2. Navigation

As defined in Notice to Mariners No 17, The North Channel Traffic Separation Scheme (TSS), under the authority of the International Maritime Organisation (IMO) lies within the vicinity of the Development Site.

The Rathlin Island Ferry operated by Rathlin Island Ferry Ltd provides nine daily crossings between Rathlin Island and Ballycastle on the mainland.

There are no Marine Environmental High Risk Areas within or adjacent to the Development Site.

5.1.3. Water Depths

Water depths across the development site have been determined from Admiralty data, the British Geological Survey Map Data and detailed bathymetric survey of the waters around the North coast undertaken as part of the Joint Irish Bathymetric Survey (JIBS). As illustrated in Figure 6.3, depth varies from 25 to 130m LAT the seabed characterised with a steeply sloping gradient to around 50m from the headlands out to around 1km. The gradient levels off into the North Channel to around 120m out to around 4km.

5.1.4. Resource

The tidal resource resulting from the flood and ebb tides flowing through the North Channel is largely developed by the flow being accelerated through the narrow passage between the Scottish and Northern Irish landmasses. In addition, local bathymetric effects resulting from a subsea spur which extends out from Fair Head acts to further accelerate the flow by constraining it in a vertical direction. Tidal resource is presented in more detail in Chapter 6 Physical Description.

5.1.5 Environmental Constraints

With reference to the NI SEA, ORESAP and RLG there are no designated areas within the development site. However, some do exist in the vicinity and further detail is provided in Chapter 8, Protected Sites and Species.

5.2 Proposed Development

The project has been split into two distinct elements, the marine works including turbines, cables, associated offshore infrastructure and landfall below mean high water springs (MHWS) and the onshore works including cabling, substation, operation and maintenance facility and onward connection to the grid system above low mean water springs (LMWS). This approach has been adopted for two reasons. Firstly, the consenting authorities are different departments for marine and onshore works with the DoE MD and DETI advising on marine aspects and The Planning Service for onshore works (plus the local council for infrastructure). Currently, the second element cannot proceed until the first has been completed and therefore there is a phasing of project effort. However, consultation on the grid connection process is currently ongoing and information pertaining to onshore works has been provided where available.

5.3 Marine Works

5.3.1 Tidal Energy Convertors (TEC) Configurations

TECs are fundamentally defined by three elements as illustrated in figure 5.3, hydrodynamic subsystem, and the power take off subsystems together the energy capture element and the support, mooring and foundation structure:

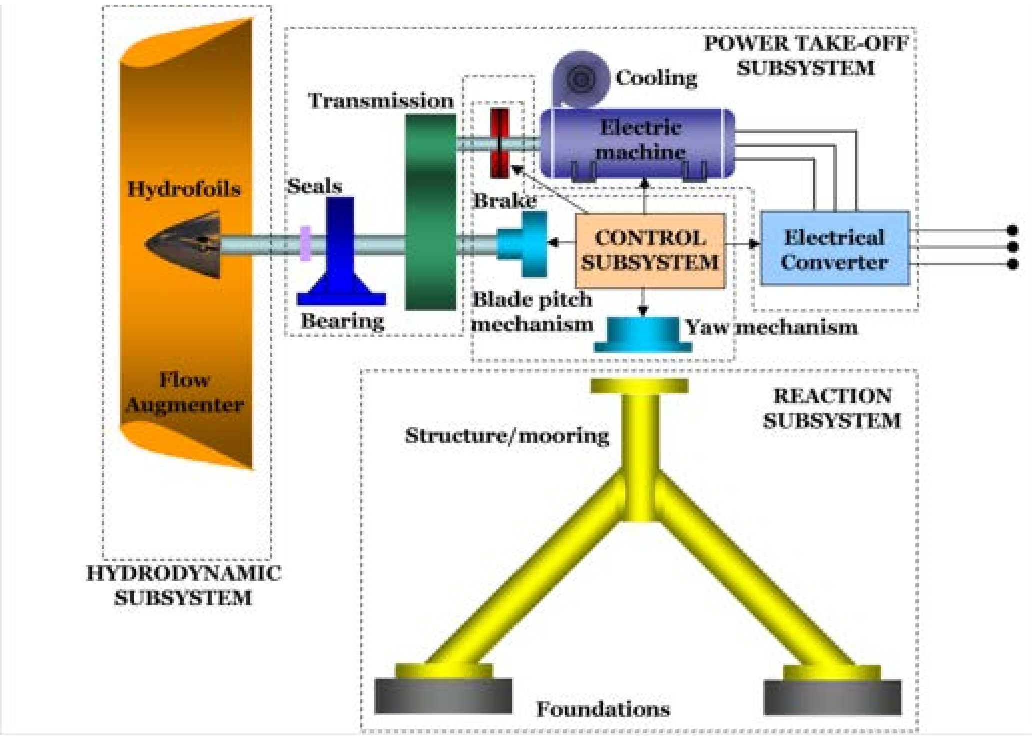
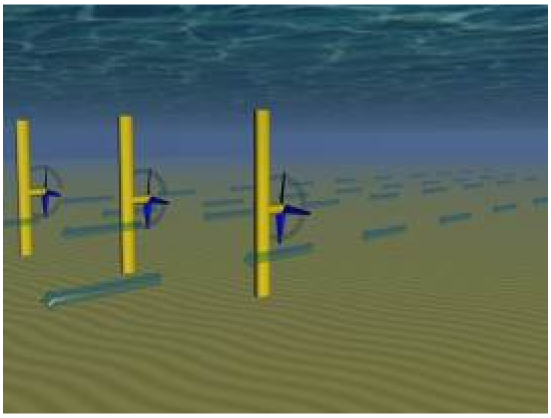


Figure 5.3: Subsystems of a TEC

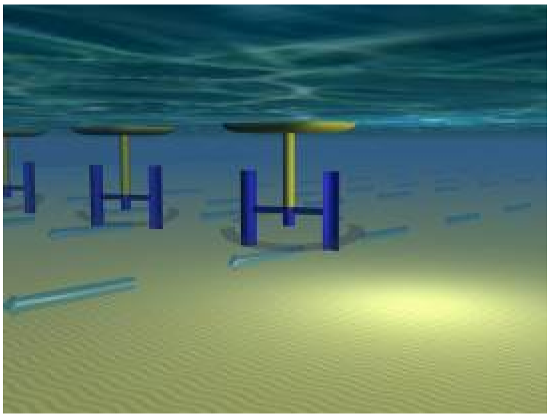
For the purposes of this scoping proposal, and based on the types of technology described below the combined hydrodynamic and power take off subsystems are generically described as the TEC's energy capture device or since we are primarily interested in rotating machinery, the turbine.

5.3.1.1 Energy Capture Devices or Turbines

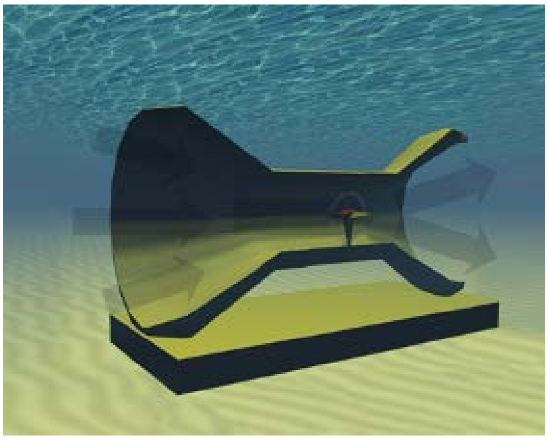
The energy capture element of the TEC converts tidal energy to mechanical and then electrical power by means of a horizontal or vertical axis turbine, or an oscillating aerofoil. A horizontal axis turbine could feature either an open or closed (venturi effect) rotor, pitched or non-pitched blades or yawed rotor. Schematic examples of such devices are shown in figure 5.4:



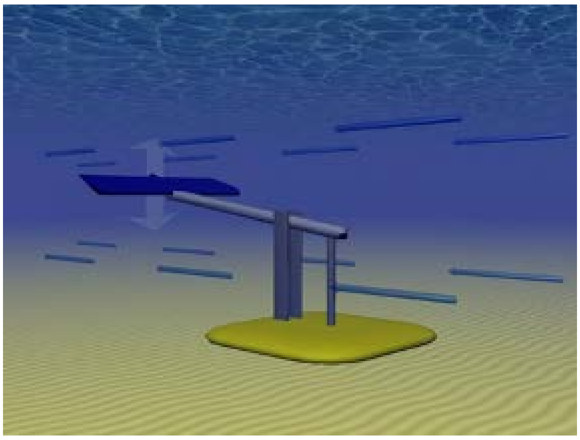
Horizontal Axis Turbine (HATT)



Vertical Axis Turbine (VATT)



Closed Rotor with Venturi Effect



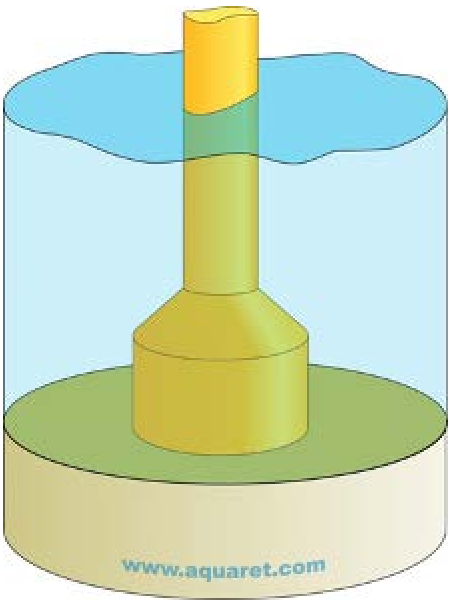
Oscillating Hydrofoil

Figure 5.4: Schematic Examples of Turbines

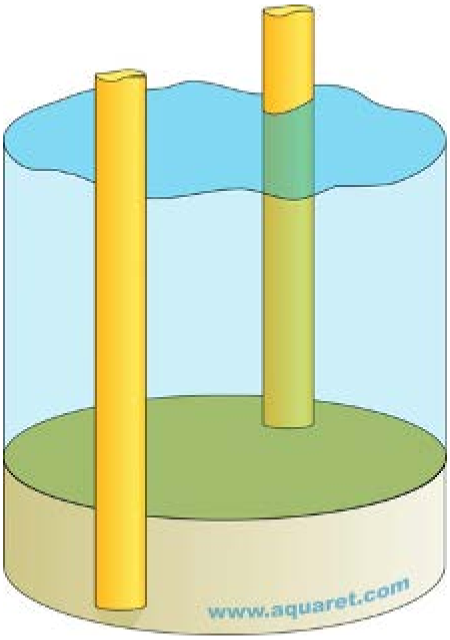
Electrical power generated from these devices can either be conditioned to enable grid quality electricity to be produced at the device or unconditioned, where the power is delivered directly from the generator without frequency converters etc and would require further conditioning prior to connection to the grid. Whilst this doesn't have a direct implication for the EIA, unconditioned power devices would require additional equipment to be installed or individually cabled back to land.

5.3.1.2 Mooring and Foundation Structure

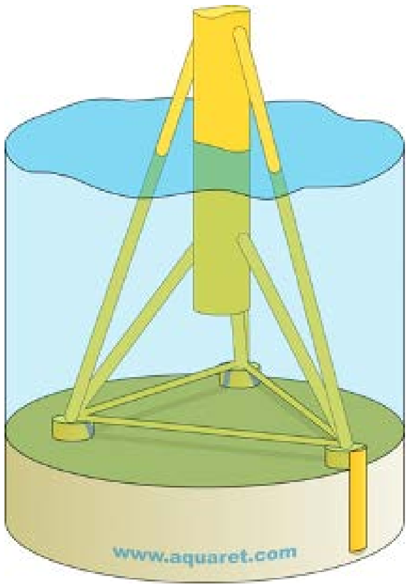
There are many different methodologies for securing the turbine in position; these include a gravity base, piled, pin-piled fixed structure or a moored floating device. The structure may be surface or non-surface piercing, both for operation and maintenance. Schematic examples of such methodologies are in figure 5.5

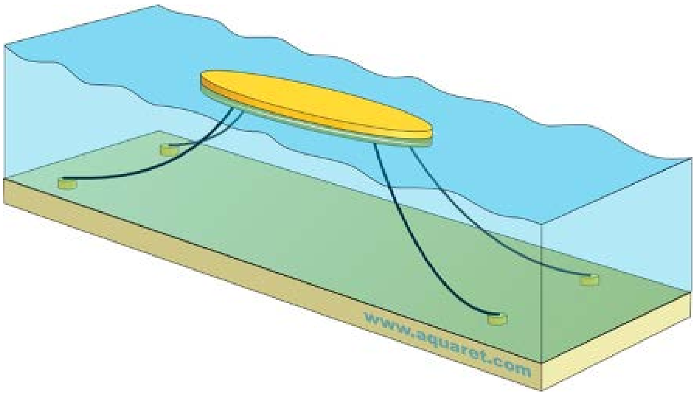


Gravity Based Foundation



Dual Piled Foundation





Pin-piled Tripod Foundation Four Point Catenary Mooring

Figure 5.5: Schematic Examples of Moorings

5.3.2 Technology Neutral Design Approach

The development approach proposed for the Project EIA and described within this scoping document is to be technology neutral. This is typical of wind turbine EIA's where final device selection is only undertaken post consent and subject to a formal commercial tender process

A design envelope, or "Rochdale Principle", approach has been adopted for this consent application. A wind farm would typically consent on a design envelope defined by maximum rotor diameter, hub height and sound power levels etc., leaving aside items that do not impact on the EIA such as generator, gearbox and control configuration specifications.

Similarly the developer will seek to define, in the course of development, the critical design envelope for the proposed tidal project, thus allowing deferment of technology and manufacturer selection to the appropriate time.

5.3.2.1 The Proposed EIA Design Envelope

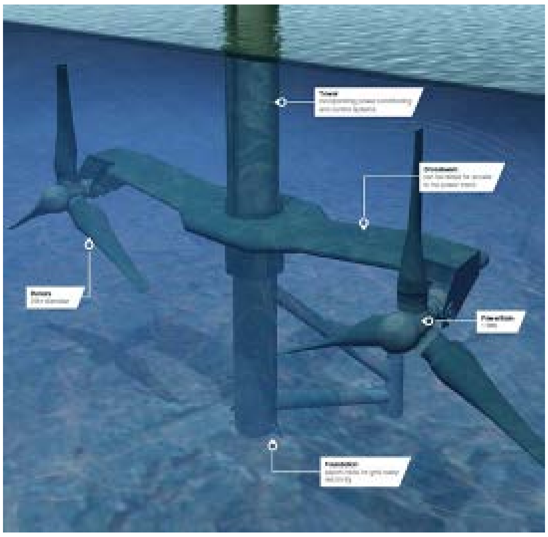
It would be impracticable to define an extremely wide design envelope which could accommodate all of the potential tidal energy options and their range of impacts within an EIA. However, enough flexibility needs to be built into the EIA process to enable a sufficient range of devices and technologies to be considered for selection at the time of deployment.

In order to maintain flexibility the key elements are selected and considered on a realistic "worst case" basis, each being appraised in relation to the various potential impacts. An obvious example of worst case scenario would be visual impact with the presumption that at least some part of the structure could be surface piercing or floating.

The key objective of the project design envelope is to assess the potentially greatest environmental impact in each specific area whether visual, navigational, or ecological.

5.3.3 Open Rotor Horizontal Axis Turbine

Although currently no standardised technology solution for extracting tidal energy, there is a clear mainstream technology strand developing based on a turbine utilising an un-ducted horizontal axis rotor (two or three bladed) and the EIA will be undertaken on the basis that the one of these will be selected. A number of manufacturers have adopted this approach including at MW and multi MW scale Siemens MCT (Marine Current Turbines), Andritz Hammerfest, Alstom TGL, Voith Hydro, Kawasaki, and at a sub MW scale Tocardo and Schottel among others. A selection of these are illustrated in figure 5.6.



Siemens/MCT SeaGen S Mark 2 – 2MW

Alstom – 1MW

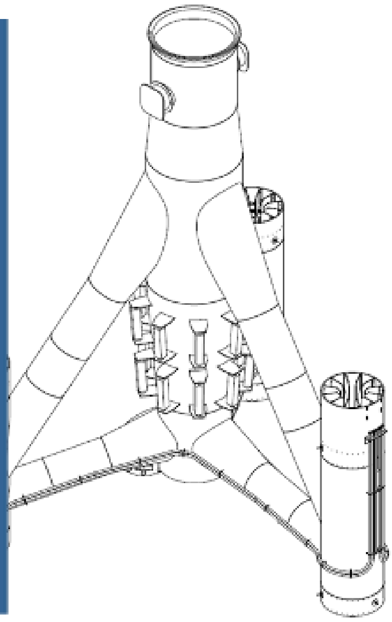
Andritz Hammerfest Strom AK1000 – 1MW

Voith Hydro – 1MW

Figure 5.6: Selection of Open Rotor Horizontal Axis Turbines

5.3.4 Foundation - Support Structures

A number of installation and mounting technologies have been considered for the un-ducted open rotor horizontal axis turbine. The MCT/Siemens device incorporates two turbine units attached to a lifting cross arm mounted on a steel tower anchored in the seabed (the Seagen S). Alstom's turbine is mounted on a tripod support structure pinned to the seabed, these examples are shown in figure 5.7. Hammerfest Strom propose a similar tripod foundation but with gravity ballast used to keep the structure in place.



Siemens/MCT Foundation Arrangement

Alstom Foundation Arrangement

Figure 5.7: Schematic Examples of Foundation Arrangements

One of the key challenges for the tidal energy industry is the high installation, deployment and maintenance costs and different approaches to seabed mounting have been considered. Alternative floating solutions for turbine deployment of both vertical and horizontal axis machines have also been proposed by third party technology suppliers such as the BlueTEC device (Figure 5.8) by Bluewater Energy Services.

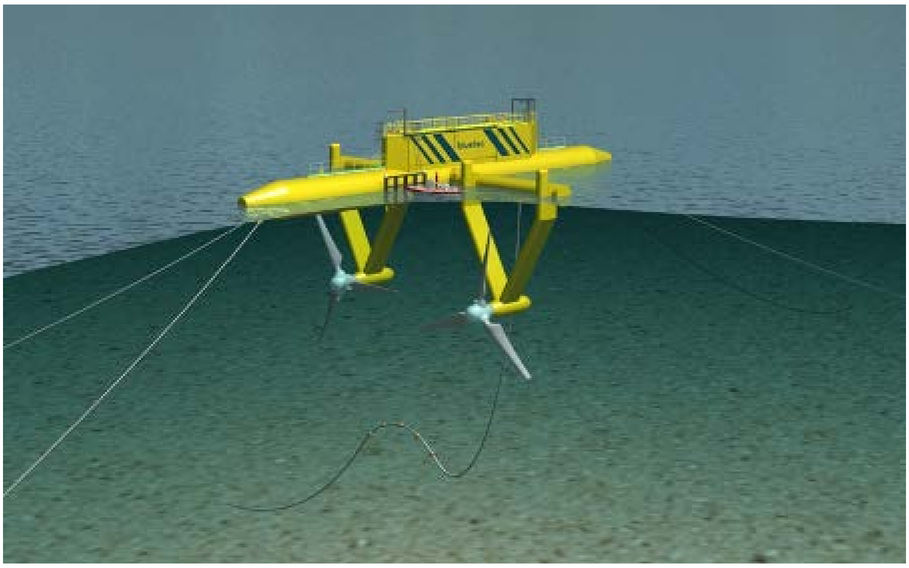


Figure 5.8: BlueTEC Floating Platform

5.3.5 Materials

The majority of the material for tidal devices is found in the foundations and steelwork designed to support the drive trains. The predominant material is an S355 or standard offshore marine steel.

5.3.5.1 Hydraulic Systems

Almost all tidal generation systems utilise hydraulic closed loop systems to drive motors required for key operations, this includes winches and lifting mechanisms, clamping systems, and braking systems etc. A few devices use seawater lubricated bearings and most hydraulic oils used are biodegradable.

5.3.5.2 Corrosion Protection

Corrosion protection techniques are broadly similar to those currently used in the marine industry. Techniques range from the use of offshore grade paints to anodic sacrificial protection.

5.3.5.3 Anti-fouling

The prevention of marine growth is an important consideration, even in a fast flow environment and it is likely that all devices will have common anti fouling strategies although a number of different approaches, including antifouling paints are being explored on full scale prototype devices. A degree of marine growth on the foundation structure is likely particularly on devices where the foundation is likely to remain in place for the life time of the project and is not recovered on servicing. However, even minor blade contamination could seriously affect flow over the surface and reduce yield performance and this would be one of the primary areas of concern particularly in the event that the turbine were out of operation for any significant period.

5.3.5.4 Scour Protection

The decision on whether to install scour protection will be made once the detailed design of the support structures has been performed, i.e. during the post-consenting phase but the indications of the surveys completed to date suggest that scour protection will not be necessary.

The installation of scour protection, if required, will be subject to review by regulators and consultees and it is acknowledged that the placement of scour protection post consent may require an additional Marine Licence.

5.3.5.5 Device Location Marking

The positions of the device structures, moorings, and export cable and ancillary structures will be conveyed to the UK Hydrographic Office so that they can be incorporated into Admiralty Charts and the Notice to Mariners procedures.

The lighting and marking of the devices and the array will be to a specification required by Trinity House Lighthouse Service (THLS) and the Maritime and Coastguard Agency (MCA), and will be in accordance with International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) standards. Additional guidance will be taken from:

- IALA Recommendation O-139 – On the Marking of Man-Made Offshore Structure Edition 1 Dec 2008;
- Department of Energy and Climate Change (DECC) Revised Standard Marking Schedule for Offshore Installations 04/11; and
- MCA Marine Guidance Note MGN 371 (M+F) - Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practice, Safety and Emergency Response Issues.

Physical marking of projects poses some challenges for non-surface piercing devices in high tidal stream areas particularly on exposed west coast sites where the combined effects of waves and tide action can make surface buoys expensive to moor and maintain. One of the benefits of surface penetrating devices whether the solid seabed mounted SeaGen S or floating and moored BlueTEC, is the facility to provide a platform for addition of aids to navigation. For these devices it is assumed that they will be both lit and painted as a special purpose marks (predominantly yellow RAL 1003). It is also likely that the devices will be equipped with either automatic identification system (AIS), and radar reflectors/transponders or both.

5.3.6 Turbine Array Interconnection Methodology

For near shore tidal farms the option exists for cabling individual turbines to shore and then grouping within an onshore substation. For tidal farm proposals further offshore or for larger projects the individual cabling solution would result in the need for the supply of large cable quantities, and result in increased transmission losses and is generally not considered to be economically viable. This leaves a number of options:

- Daisy chaining a number of turbines together to form small clusters and exporting ashore along a single cable per cluster;
- Connecting individual turbines to a central platform (subsea or surface penetrating) and then shipping ashore potentially at a higher voltage; or
- A combination of both - assembling clusters of turbines at a central platform and then exporting via a single usually higher voltage cable.

The choice of TEC and in particular whether they are surface penetrating or entirely subsea has a significant impact on the feasibility of these options.

5.3.6.1 Inter-Array Cabling

The inter-array cable voltage will depend on the individual device generator and transformer design which in turn will depend on device philosophy and physical space within the nacelle. However, this is likely to be of the order of 6.6 - 33 kV as it is within the wind industry. The cables are typically 3-core copper conductors with insulation/conductor screening and steel wire armouring. The insulation will be either dry type cross linked polyethylene (XLPE), wet type XLPE or a combination of both. All cables will contain optical fibres embedded between the cores. The cable dimensions would depend on the load current that the cable is required to carry and this may vary depending on the layout design and whether machines are daisy chained or individually connected back to the marshalling turbine(s).

5.3.6.2 Cable Protection/Ballasting

Regardless of the device type the need for subsea cabling between machines and between tidal farm and shore brings with it significant challenges. The majority of tidal sites are heavily scoured by virtue of the high tidal velocities and consequently the seabed has few deposits which would enable easy cable burial for protection. If left unprotected, in the high current and constantly reversing flow, cable movement will result in abrasion and wear of the protective armouring.

Laying subsea cable is in itself not a new technique and there are many submarine cables for telecommunications and electricity. However, the challenges in this instance are laying cables in a high tidal energy environment and subsequently protecting the cable from potential damage due to that environment. Careful cable routing utilising natural seabed features can help keep the armoured cable out of the most aggressive tidal flows until the cable run reaches lower velocity areas.

Once in areas with lower tidal movement, and seabed sediment it is normal that the cable would self-bury over time under its own weight. In the high tidal areas where there is high energy and rock seabed, beyond the routing through natural features special techniques may also be required to protect the cable.

5.3.6.3 Cable Armouring

Cable armouring is typically employed in areas where cable burial is not possible and/or where there is a perceived high risk of damage to the cable. Cable armouring is typically available in several types including single armoured and double armoured.

Single armoured cables are unlikely to be of sufficient weight to remain in-situ in the high tidal currents on their own and may require some sort of ballasting. It is likely that unless other options such as rock dumping or placement of concrete mattresses prove more suitable, double armoured cable will be used since it is both significantly heavier and will also provide greater protection from damage.

Double armoured cable (figure 5.9) typically consists of an inner armoured layer with steel wires of approximately 5mm in diameter surrounding the conductors, which would then be overlaid with a second layer of armouring with steel wires of 7mm in diameter.

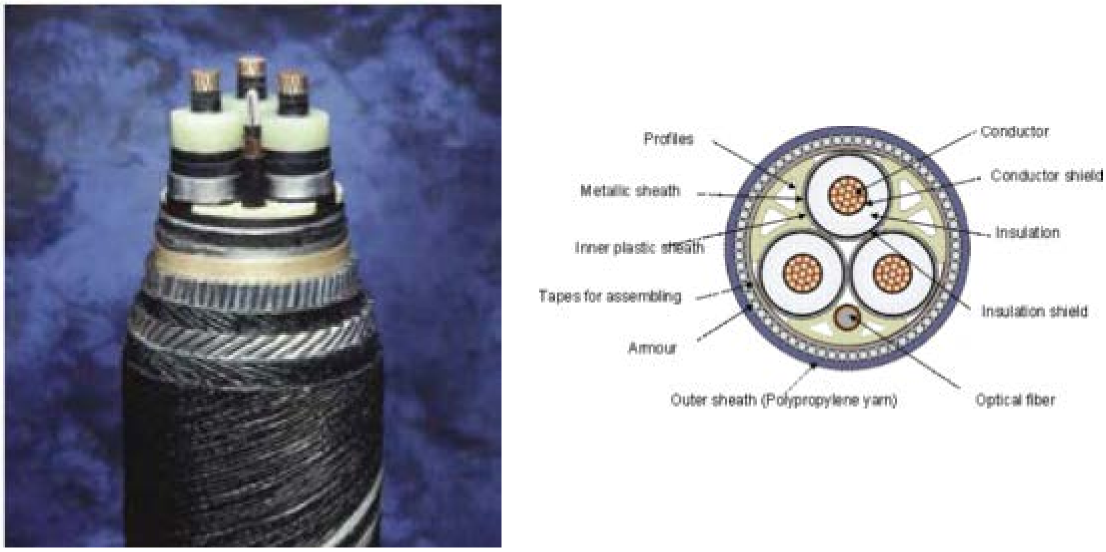


Figure 5.9: Typical Cross Section of a Double Armoured Cable

5.3.6.4 Rock Placement

Rock placement is an established practice for protecting subsea cables however it is unlikely to be a suitable solution for the inter-array cables since the size of rock required to resist the currents will be too great.

5.3.6.5 Ballasting with Rock Bags Grout Bags, Sand Bags or Stone Mattresses

Stone, grout or sand bags are usually installed by divers or remotely operated vessels (ROVs) to stabilise or fix in place a cable over short distances. Grout bags can either be deployed as pre-filled bags or for larger applications empty fabric bags are taken to the seabed and a diver coordinates the filling of the grout bag using a grout mix and pumping spread from the host vessel above. This option may be used in discrete areas.

If utilised it is most likely that 2 tonne rock bags would be employed to ballast cable strategically placed at frequent intervals (figure 5.10).

Ballasting with Stone Bags in Situ

Rock Bags Being Lowered

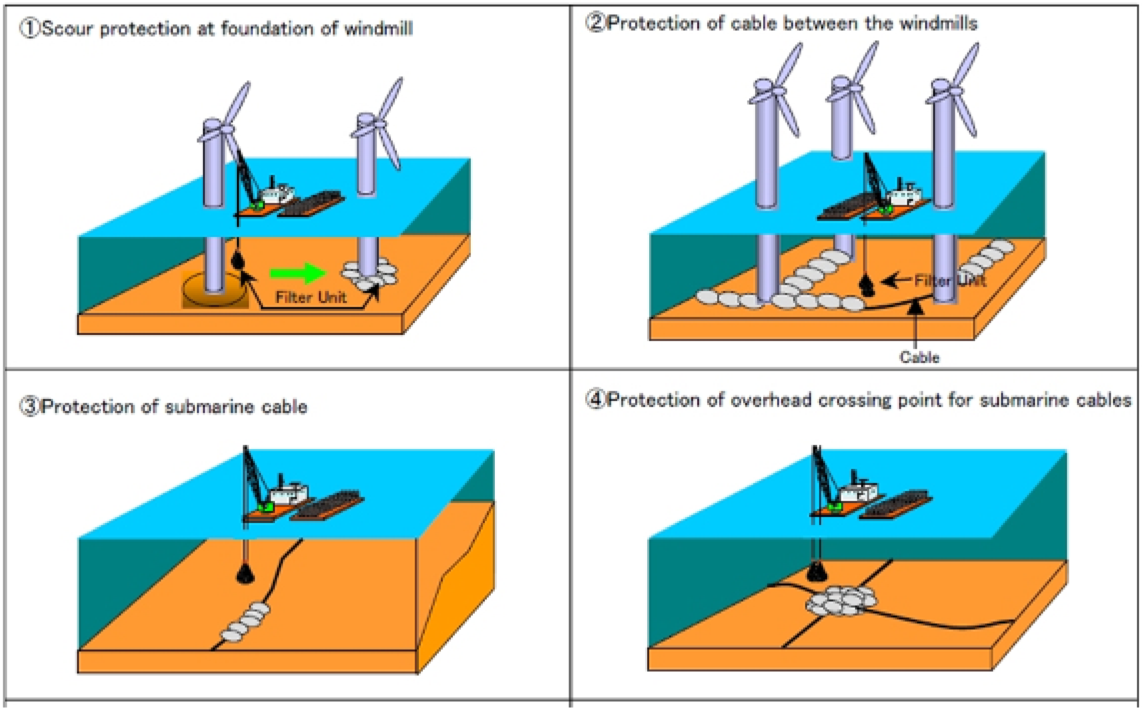


Figure 5.10: Different Applications for Rock Bag Installation

5.3.6.6 Ballasting with Articulated Metal Shell Connectors

Articulated metal shell connectors (figure 5.11) are typically used to provide cable sections with added mass and abrasion resistance in high energy environments such as cable shore landings, rock outcrops and where other forms of cable burial are not possible. The articulated sections are typically applied by divers in half sections which are then locked or bolted together to form a continuous pipe section. This option may be used in discrete areas where the weight of the cable is not sufficient and is the most likely ballasting option.

Figure 5.11: Cast Iron Cable Casings

5.3.7 Export Cable to Shore

The outline connection proposal is based around use of one or more double wire armoured sub-sea cable from the project to landfall with an expected export voltage of around 33kV. A review of connection options via either single or multiple cables from a single turbine marshalling point as described above or from multiple cables from multiple marshalling points will require to be undertaken as the project develops. Higher voltage options up to 132kV are also being considered which may enable use of a single cable rather than multiple 33kV but this still remains to be determined.

5.3.7.1 Cable Type

The 3-core cable being considered comprises copper conductors with integral insulation, core screening, and steel armour (for stiffness and impact resistance). The cable would have a polypropylene outer sleeve with an external diameter of approximately 150mm (33kV) and 300mm (132kV). The AC cable will also include internal fibre optic communication links for control purposes.

5.3.7.2 Cable Protection/Ballasting

Similar techniques as those reported in Section 5.3.6.5 will be utilised depending on the seabed structure throughout the length of the export cable from the tidal site to landfall.

5.3.7.3 Offshore Cable Route and Landfall Locations

The most likely option for export is for multiple subsea power cables rated at 33kV from the tidal site to landfall.

The technique for making landfall depends on the shoreline geography. If the landfall is rocky and steeply inclined, directional drilling may be required. However, where a shelving beach is available it is possible to trench the cable at low water through the intertidal zone, and plough the cable to a suitable distance off the beach to ensure the cable is not visible and safely away from human contact.

The short stretch of trench below low water will be created using an underwater plough as shown in figure 5.12 towed by the cable laying vessel after the cable has been pulled ashore. The landfall trench in the tidal zone will most likely be excavated and backfilled using shore-based tracked excavators (figure 5.13).

Figure 5.12: Plough for Shallow Waters and Intertidal Zone

Figure 5.13: Onshore Cable Trenching

It is anticipated that the cable will be laid in a trench approximately 2m deep through the surf zone and across the beach (figure 5.14).

Figure 5.14: Tidal Zone Cable Plough Trenching

After the cable has been pulled ashore the trench in the tidal zone will be backfilled to its original condition with beach sand.

5.3.8 Installation

5.3.8.1 General

Turbine support structure design, foundation design and consequently installation methodologies and costs are some of the main drivers in tidal energy park economics. Installation methods will vary from device to device, and from contractor to contractor and it is also possible that final methodologies may have to be adjusted dependent on availability of vessels at the time of construction. Therefore maintaining flexibility in installation options and designing an envelope is critical.

A detailed Construction Methods Statement (CMS) incorporating an Offshore Cable Feasibility Assessment (OCFA) will be produced prior to commencement of construction based on the final TEC selected, the identified contractor and the vessels proposed for installation. This will detail vessel movements, types and numbers and specific methodologies and mitigation measures adopted.

To date there have been no commercial tidal arrays installed or full industrial scale installation methodologies and systems proven.

Clearly the large size of the foundations requires sea transport and fabrication of the heavy structures is therefore conducted close to or at existing port facilities.

The major turbine equipment including the nacelle and drive train can be manufactured elsewhere and delivered by land to the seaport before mobilisation and deployment. This may involve splitting the turbine up into subassemblies based on weight or dimensional restrictions. Ancillary barges, tugs, safety vessels and personnel transfer vessels will also be required.

No decision has been made with regard to the most appropriate port facility for mobilisation but a number of options exist in the vicinity of the site, the closest being at Belfast although Glasgow Port and Mostyn might also be possible, the locations of which are shown in Figure 5.28.

5.3.8.2 Pre-installation Works

Detailed metocean studies, geophysical and geotechnical surveys will be required prior to construction which will inform any micro siting or pre-installation works required. Following these seabed surveys each foundation location will be chosen and oriented in order to minimise potential seabed preparation works. Initial information from the preliminary geophysical surveys and camera work undertaken to date suggests that pre-installation works such as the removal of boulders is unlikely (more so because gravity based foundations are not being seriously considered) but this will require more detailed assessment before a final decision is made.

5.3.8.3 Vessels and Device Transportation

One option for the main installation is that one vessel will remain on site carrying out installation activities while a transport barge will be tasked with sailing between the installation site and the base port for loading of the components. Another option is a barge and winch system. All options will be assessed for suitability. The number of vessel movements will depend on the size and type of vessel and the selected turbine technology..

The table below illustrates a range of typical scenarios for delivery of turbine and foundation equipment to site.

Type of Installation Vessel	Large size Jack up barge as installation vessel	Medium size Jack up barge as installation vessel	Dynamic positioning scenario
Size of vessel	150m x 45m	68 x 38m	155m x 30m
Foot print of mooring system	X4 triangular lattice spuds with circa 140m^2 spud area	4 circular spuds ca. 10m² spud area (possibly extended with spud cans)	Dynamic positioning holding a footprint of +/- 5m
No of tugs required	Jackup vessel is typically self-propelled	Jackup vessel is typically self-propelled, but possible X1 tugs required for initial positioning (30m x 22m)	n/a
Anchoring Handling Vessel (AHV)	n/a	n/a	n/a
Flat top barge (to bring out large items	n/a	n/a	n/a
Crew change support vessel (vessel length	up to 26m		up to 26m
Install vessel	100m x 50m		100m x 50m
SeaGen unit installed by	Same vessel	JUP vessel in case SeaGen S unit split up into multiple sections or by HLV (Heavy Lifting Vessel)	DP2 vessel in case SeaGen S unit split up into multiple sections or by HLV

Table 5.2: Foundation and Turbine Installation Vessel Options

5.3.8.4 Different Vessels Impacts

Heavy Lift Shearleg

The heavy lift shearleg vessels hold their position by means of anchors, it is most likely that the previously installed foundation piles will be used as anchors, hence there will be few additional impacts. However, there is some potential for catenary of the anchor chain as the barge manoeuvres, with some of the resulting 'slack' chain resting on the seabed. This may result in seabed abrasion for approximately 80m of seabed along the line of each of the chains in a corridor estimated as 1m wide, resulting in up to 80m^2 of potential abrasion impacts associated with each of the potential anchor points.

Jack Up Barges

If a jackup barge is used the worst case footprint could be a vessel which has 4 "spuds" each with a footprint of 140m^2 each. The vessel will Jack-up at least once at each turbine location.

DP Vessels

DP vessels may be used on the project but if they are they are most likely to be relatively small compared to the vessels already described. DP vessels do not have any direct contact with the seabed since they are held in position by a number of thrusters.

5.3.9 Project Phases

The project is envisaged to take place in four phases as follows:

- Design / permitting;
- Construction;
- Operation / maintenance; and
- Decommissioning.

5.3.9.1 Phase 1 Design / permitting.

The major elements in no particular order are as follows:

- Site surveys to confirm currents, seabed bathymetry and geophysics;
- Preliminary consultation and scoping report;
- Final evaluation of all leading or emerging tidal technologies and selection of device(s) for the project;
- Site / location selection of individual device location;
- Subsea cabling design and routing;
- Final surveys of devices locations and cable routes;
- Preparation of EIA and submission of the consent application;
- Procurement of the various licences and consents; and
- Procurement of all necessary material and installation activities.

5.3.9.2 Phase 2 Construction

The project as currently envisaged will have a total installed capacity of 100MW consisting of individual devices of approximately 1.0 to 2.0MW each. The array will be completed in phases between 2017 and 2020. The construction is expected to be phased over a number of years with installation mainly taken place in the months between March and November depending on environmental considerations. Deployment of devices will begin in 2017.

The foundation structures are the largest, bulkiest and heaviest elements of the project. Large lay down areas are required for the assembly of materials, cutting and fabrication. This must be adjacent to relatively deep water where fabricated units can be transferred to jack up barges or other custom designed vessels. Harland & Wolff's facilities in Belfast would be an ideal location, having previously completed a similar unit for the SeaGen project in Strangford Lough for example.

Each foundation unit will be transported to the site and deployed to the seabed at predetermined locations. Pining to the seabed will be carried out using the same vessel or alternatively a vessel equipped with a dedicated piling device. Risings from the drilling operation are generally in the form of fine solids which will be allowed to disperse in the area.

The top or generating / rotor elements of the units will be similarly assembled as close to the site as possible. Assembly is used as this element contains a number of elements such as generator, gearing mechanisms, rotor pitch control mechanism and rotors. These individual elements may be manufactured in diverse locations but like the foundations will require indoor assembly / fabrication facilities close to relatively deep water for dispatch to the array site.

Typically jack up barges are used to erect the tidal energy converter onto the foundation structure although other methodologies are also used as in SeaGen's case in Strangford Lough.

Cable Deployment

Subsea cabling is a specialist item which is on a long lead time for materials and installation due to the expansion of the offshore wind industry. These cables typically are loaded on the specialist cable installation vessel at port. Dedicated cable barges exist to carry additional material if the project's cable supplies cannot be accommodated on the vessel, however, large cable deployment vessels can typically carry up to 70km of cable.

In addition to the main installation vessels a number of supply and safety vessels will be required to support the main installation vessels.

Cable landing will also require smaller inshore vessels. Cables are typically floated in to the landing location guided by smaller craft at high tide. The cable is then positioned over a prepared trench or horizontally directionally drilled conduit and lowered into position at low tide. A cable winch (up to 30 tons in weight is position at the shoreline is then used to winch the cable ashore.

The North Antrim region has several harbours and ports. Large harbours on the east coast include Larne and Belfast which would be the nearest major port to support machine installation craft etc. Smaller harbours at Ballycastle, Port-aleen Bay, Cushendun and Cushendall which serve the local fishing and leisure craft industry could be suitable bases for survey and installation support and maintenance craft.

5.3.9.3 Phase 3 Operation / Maintenance.

The units will be operated remotely via the optic fibre control cable incorporated with the electrical cables. In addition to some inbuilt controls on the units themselves this cable will control the start and stopping of the units and pitch the blades to maximise the output in harmony with the tidal forces. The cable will also return continuous output and monitoring data on the units themselves.

The units will have a life span of approximately 25 years with major maintenance intervals every 5 years. Exact maintenance sequence will depend on specification and type of units selected. ROVs will be used periodically, 1 to 3 years, to carry out visual inspection of devices and cabling. Diver inspections will only be used when ROV data is unclear.

The system operates autonomously and scheduled maintenance of the nacelle is currently anticipated to occur as a minimum every five years. However, the maintenance period for the device will be reviewed. Maintenance of the nacelle will be carried out by removing the nacelle in a method similar to the installation in reverse, using a similar number and type of vessels. The nacelle will be taken from site to shore, where it will be maintained and any faults addressed in a clean environment.

The device will contain oils for lubrication, anti-fouling agents and hydraulic fluids. Water is also being considered as a lubricant. Only recognised marine standard materials and substances will be used in the device.

5.3.9.4 Phase 4 Decommissioning

The typical lifespan of the TECs will be 25 years at which stage decommissioning will be required. Decommissioning would involve the removal of the TECs from site using typical jackup barges and restoration of the site to as near its natural condition as possible. However, decommissioning may cause significant environmental impact in its own right, e.g. removal of subsea cables. A Decommissioning Plan will be drawn up as part of the project and all aspects of the decommissioning will undergo environmental impact assessment which will inform the final decision making process as to the best option.

5.10 Onshore Infrastructure

5.10.1 General

This scoping document is intended to define the EIA works proposed to be undertaken for the tidal farm including turbines and associated infrastructure and the subsea export cable from the tidal farm to the high water mark at landfall. It is not intended to cover onshore works.

A dedicated onshore infrastructure scoping document will be written pending further definition being provided on the potential location of an electrical connection point onshore.

However, the following information has been provided to inform the balance of the project.

5.10.1.1 Landfall to Sub-station Location

From the landfall where the 33kV subsea cable(s) or 132kV cable is routed, the cable will continue underground until a suitable location is found where it will be connected into a termination module prior to onward routing either overhead on wooden poles or underground. This decision will depend on several factors including environmental, design feasibility and cost.

5.10.1.2 Sub-station/Control Building Location and Design

It is probable that a 33/132kV sub-station will be required to be located in the vicinity of landfall to enable the sub-sea section of cable to transmit at higher voltages to reduce losses and the potential for fault levels.

Substation size is not yet defined but a fenced off area of approximately 30m by 50m within which would be a single storey substation/control building, 15m by 6m, a bounded / fenced off transformer area 6m by 6m, external switchgear and grid connection tower. A typical example is shown in figure 5.15. It is presumed that the scope/interface of the project will end at the substation with the land based grid connection designed, installed and maintained by Northern Ireland Electricity (NIE).

Figure 5.15: Typical 33/132kV Sub-station/Control Building

5.10.1.3 Operations Base in Ballycastle

An operations base will be required which may be located at Ballycastle. The facility will include offices for construction and operations management, workshop facilities for minor servicing of the turbines, spares stockholding and operational and environmental monitoring.

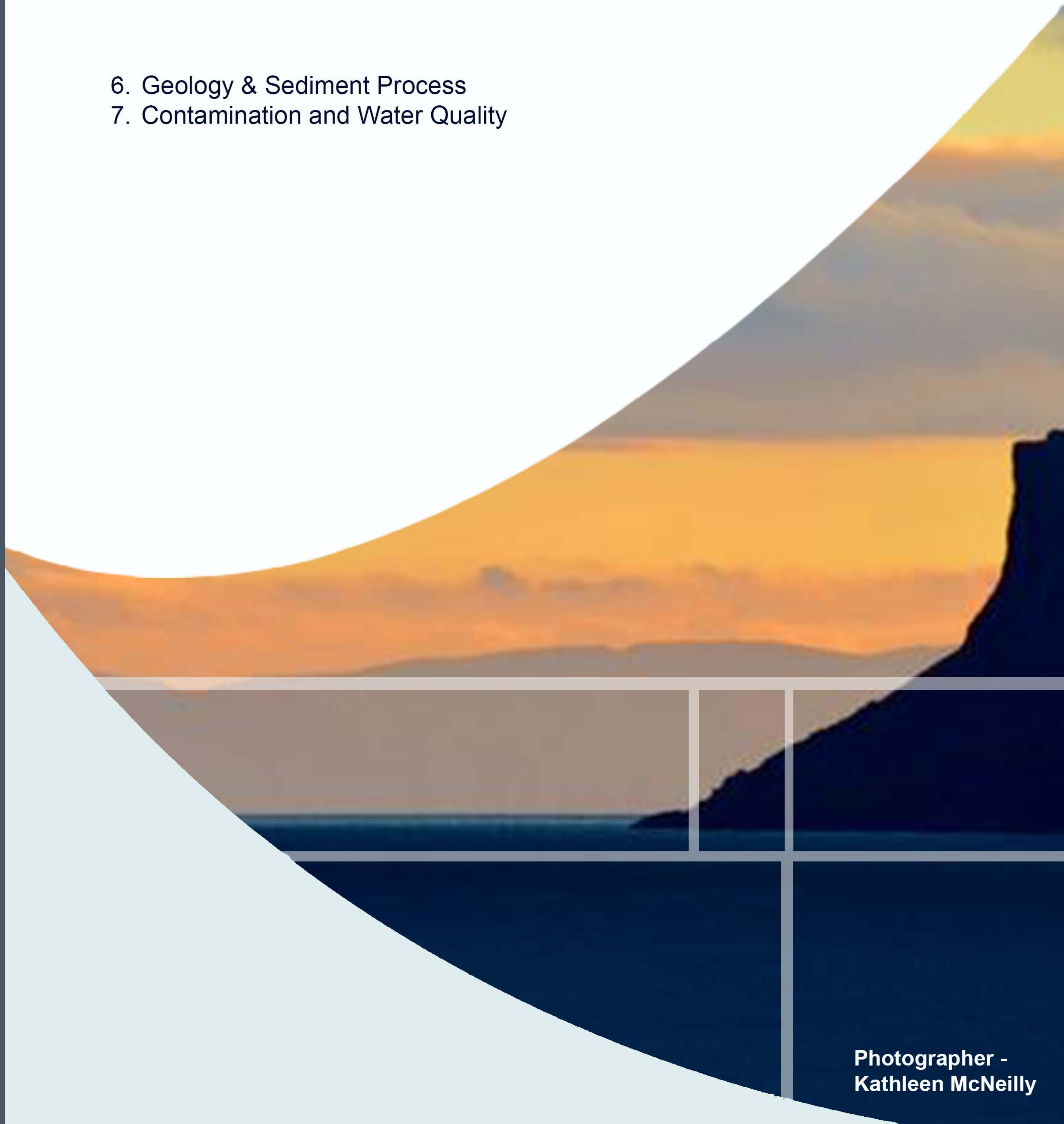
5.10.2.4 Temporary Construction Facilities

A temporary construction facility will be required to enable construction of the landfalls, electrical infrastructure and sub-station to take place.

FAIRHEAD TIDAL

Section 2: Physical Environment

6. Geology & Sediment Process
7. Contamination and Water Quality



Photographer - Kathleen McNeilly

6.0 Geology & Sediment Process

6.1 Introduction

Whilst understanding the seabed geology is not in itself an environmental issue it does provide information necessary to inform the assessment of likely or potential impacts associated with site investigation, construction, operation and decommissioning.

The construction and operation of tidal devices and the installation of subsea cables can have an effect on current regimes and attenuation of wave energy. This in turn can have an effect on sediment dynamics and scour patterns leading to effects on species existing in or around the proposed development and on the characteristics of coastal areas. Survey work is required to fully understand the natural physical environment of the site and surrounding area.

6.2 Baseline Conditions/Current Knowledge

The height of the last glacial period, commonly referred to as the Last Glacial Maximum (LGM), occurred at approximately 22–21 ka cal BP, when the British and Irish Ice Sheet (BIIS) advanced onto the continental shelf, covering all but the southern parts of Ireland and Britain (McCabe and Clark 2003). Extensive deglaciation followed between 22 and 19 ka cal BP when the BIIS lost over two-thirds of its mass (Bowen et al. 2002; McCabe and Clark 2003). The last major glacial event to have an impact on the north coast of Ireland occurred between 17.7 and 16.6 ka cal BP when, during renewed glacial activity, regional ice re-advanced southward from Scotland and over-rode the north coast (Bazley 2004). Thus, the north coast of Ireland has had a complex sea level history with sea levels rising and falling several times over the last 21,000 years (Carter 1991 and 1993).

The British Geological Survey (Malin sheet 55N 08W Sea Bed Sediments and Quaternary) based on grab samples and shallow core indicates that the Development Area consists of an extensive rock outcrop with gravelly sediments. The majority of the area from Fair Head to Torr Head falls under the category of “Shallow coarse sediment plains”. This description refers to an area of seabed characterised by coarse sediments with strong currents.

The British Geological Survey (Malin sheet 55N 08W Solid Geology) indicates that limited survey work has been undertaken off the Antrim coast. Most of the area of interest lies in the Highland Border Ridge a Dalradian with complex outliers of Devonian, carboniferous, Mesozoic and tertiary (igneous) rocks. The Tow Valley Fault at the western perimeter of the area of interest runs from Ballycastle in the south, north north east into the North Channel Basin.

With reference to the NI SEA, it is noted that:

“The Joint Irish Bathymetric Survey (JIBS), conducted in 2007 and 2008 provides full-coverage multi-beam bathymetry data within the 3 nautical mile coastal strip from Fanad Head (Co. Donegal) to Torr Head (Co. Antrim) combined with an intensive grab sampling programme. The JIBS data provides detailed, high resolution bathymetry for this part of the study area."

The land adjacent to the proposed site lies within the region described as the Antrim Plateau and Glens. This upland area is dominated by a series of structural plateaux that dip gently in towards the Lough Neagh Basin. Detailed topography is largely controlled by a succession of Tertiary basalt lava flows that define successive, large-scale steps within the landscape. The plateaux are separated from each other and their frequently dramatic margins are fretted by often fault-guided, steep-sided glens. Recession of the plateaux margins in the north of the region around Fair Head has exposed the underlying Palaeozoic basement. The plateaux margins are typically characterised slope failures that range from large rotational landslides to individual block falls. The geological environment can be divided according to main groupings of material, based on age and geological processes;

- Bedrock geology - these are rocks older than 1.8 million years old formed before the last ice age
- Drift (Quaternary) geology - these are rocks deposited since the start of the last ice age and are from 1.8 million to 10,000 years old
- Seabed Sediments - these represent the youngest materials and formed from reworking of either the solid and Quaternary material, river inputs of sediments or the creation of new material such as biogenic shells

6.2.1 Bedrock Geology

The Rathlin Basin, a post-Variscan half-graben with a sedimentary fill comprising mainly Permian, Triassic and Cretaceous strata (Johnston 2004, 205), is located in the south Malin Sea. The basin, formed in response to extension along faults trending north-north-west/south-south-eastwards in the area between the Tow Valley and Lough Foyle faults, extends northwards offshore beneath Rathlin Island and southwards to the Tow Valley Fault.

The geology of North Antrim is dominated by Cretaceous chalk and Tertiary basalt (Figure 6.1). The Late Cretaceous period (99.6–65.5 Ma) saw global sea level rise by 200m above present, drowning Ireland in a warm and shallow sea, and initiating the formation of one of the most distinguishing elements of the landscape, its chalk beds. Chalk formation resulted from the accumulation of organic deposits derived from mixed fragments of carbonate shells of plankton and calcareous algae on the seabed. That in the Rathlin Basin, one of the main depositional areas of Ulster White Limestone, is extremely hard compared with much of the English Chalk Group, due to calcite cementation in the pore spaces caused by sediment loading following deposition (Mitchell 2004a, 149–160).

Locally, lateritised basalt underwent contact metamorphism and formed porcellanite (Dawson 1951), an extremely tough rock highly prized by Neolithic toolmakers for its ability to hold a sharp edge and take a high polish. Porcellanite is known to occur at only two sites in Northern Ireland – Tievebulliagh, near Cushendall in Co. Antrim and at Brockley on Rathlin (Dawson 1951; Preston 1971; Bazley, 2004). Throughout the early Palaeogene (*c.* 65 million years ago), igneous intrusions induced by tectonic extension of the continental crust, coupled with the emplacement of dolerite plugs, had a significant impact on the Antrim Lava Group

(Cooper and Johnston 2004). Volcanic activity continues in the North Atlantic today, and the stark volcanic landscape of Iceland may provide insights into the environment at the formation and modification of the Antrim Lava Group.

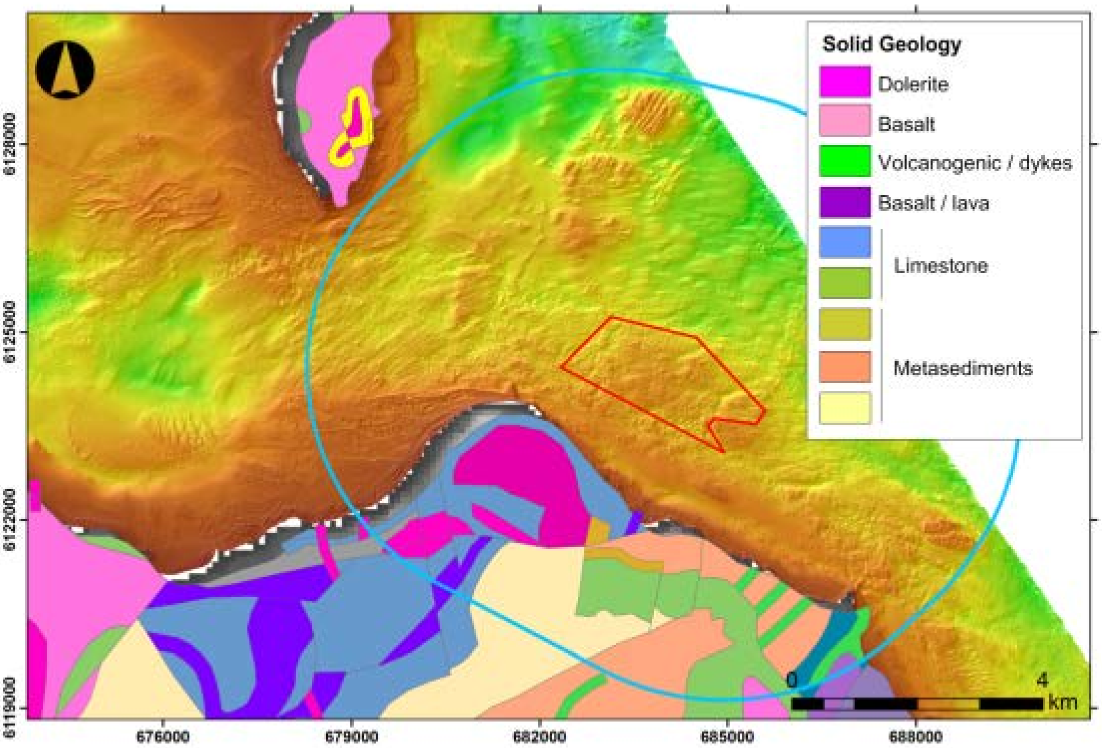


Figure 6.1: Solid Geology Map of the Study Area derived from the 1:250k Geological Map of Northern Ireland (GSNI).

The headland at Fair Head is a dolerite sill, emplaced during the Tertiary as molten lava into gently dipping Lower Carboniferous shale. Erosion of the overlying limestone beds has left the sill as a dramatic promontory. Vertical jointing of the dolerite forms impressive columnar structures that emphasise the sheerness of the cliff face. The cliffs at Fair Head rise approximately 120m above sea level and are fronted by an apron of talus slopes comprising accumulated debris from toppled and fractured columns.

6.2.2 Drift (Quaternary) Geology

The height of the last glacial period, commonly referred to as the Last Glacial Maximum (LGM) occurred at approximately 22,000–21,000 BP, when the British and Irish Ice Sheet (BIIS) advanced onto the continental shelf, covering all but the southern parts of Ireland and Britain (McCabe and Clark 2003). Extensive deglaciation followed between 22,000 and 19,000 BP when the BIIS lost over two-thirds of its mass (Bowen et al. 2002; McCabe and Clark 2003). The last major glacial event to have an impact on the area occurred between 17,700 and 16,600 BP when, during renewed glacial activity, regional ice re-advanced southward from Scotland and over-rode the north coast (Bazley 2004). The glacial deposits in North Antrim are thin, with glacial sediments limited to deposits of till, alluvium, peat and sands and gravels (Figure 6.2). Soils formed in the area are strongly correlated to the underlying geology. Calcareous soils found on top of the limestone bedrock are well-drained, sheltered and the most fertile, while the acidic soils associated with basalt are less fertile and generally more exposed to the elements.

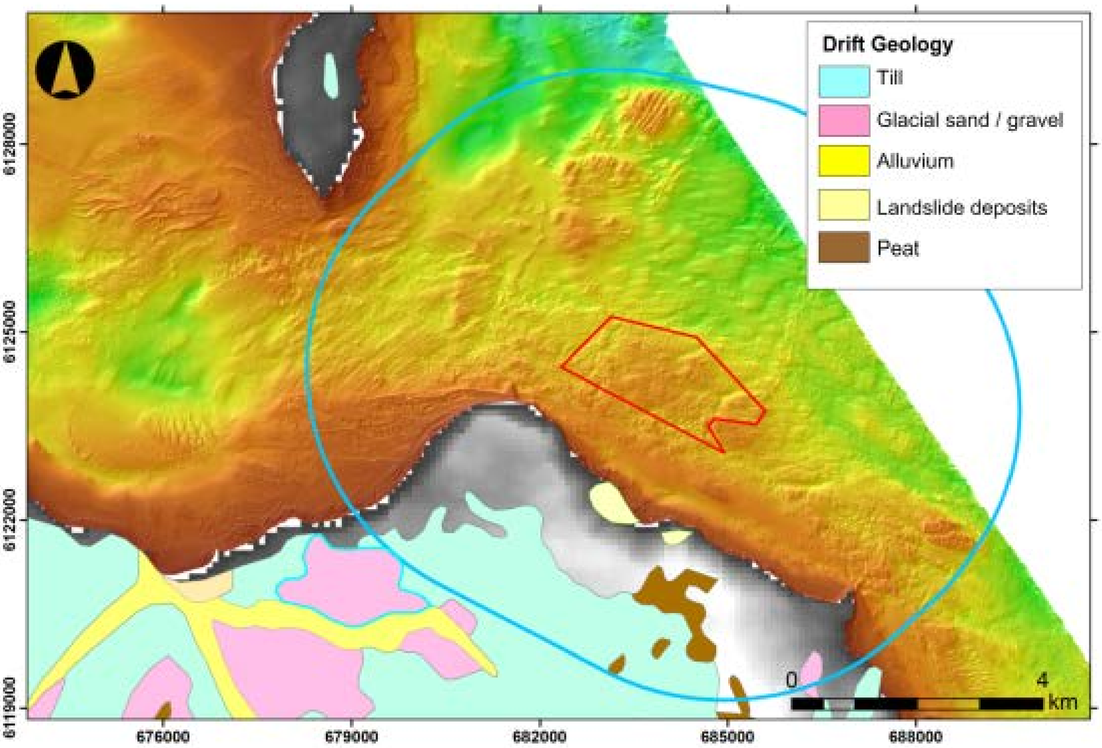


Figure 6.2: Drift Geology Map of the Study Area Derived from the 1:250k Drift Map of Northern Ireland (GSNI).

6.2.3 Seabed Sediments

These represent the youngest materials and formed from reworking of either the solid and Quaternary material, river inputs of sediments or the creation of new material such as biogenic shells. The seabed in the area under consideration is deemed to be mainly compacted coarse gravel sediments. The strong tidal currents in the area prevent the deposition of finer material. Bedrock may be exposed on the seabed across some areas of the site. The hydrodynamic regime in the North Channel is reflected in the form and orientation of sea-bed features (Fyfe *et al*. 1993, 75). Localities with the highest peak-tidal currents (more than 1.5ms^{-1}) are commonly sediment-free, bare-rock platforms or may have transverse gravel ridges. There is no ground-truthing for the JIBS data in the area, and so sediment sampling will form part of the EIA.

Towards Ballycastle the coast is characterised by cliffs subject to slow erosion. Longshore drift is westerly with sediments accumulating at the mouth of the river on the western side of Ballycastle Bay. The bay has suffered from loss of dunes and severe erosion at its eastern end. From Ballycastle to Fair Head the coast is formed from various igneous and sedimentary rocks, with high cliffs at Fair Head, all undergoing slow erosion (Buck, 1997).

6.2.4 Bathymetry

Water depth across the general area varies considerably reaching depths of over 100m. Target depths for the Fair Head proposal range from 27 and 50m in depth.

These areas have been identified from Admiralty Chart Data and the more recent and detailed bathymetric survey of the waters around Northern Ireland which has been undertaken as part of the Joint Irish Bathymetric Survey (JIBS).

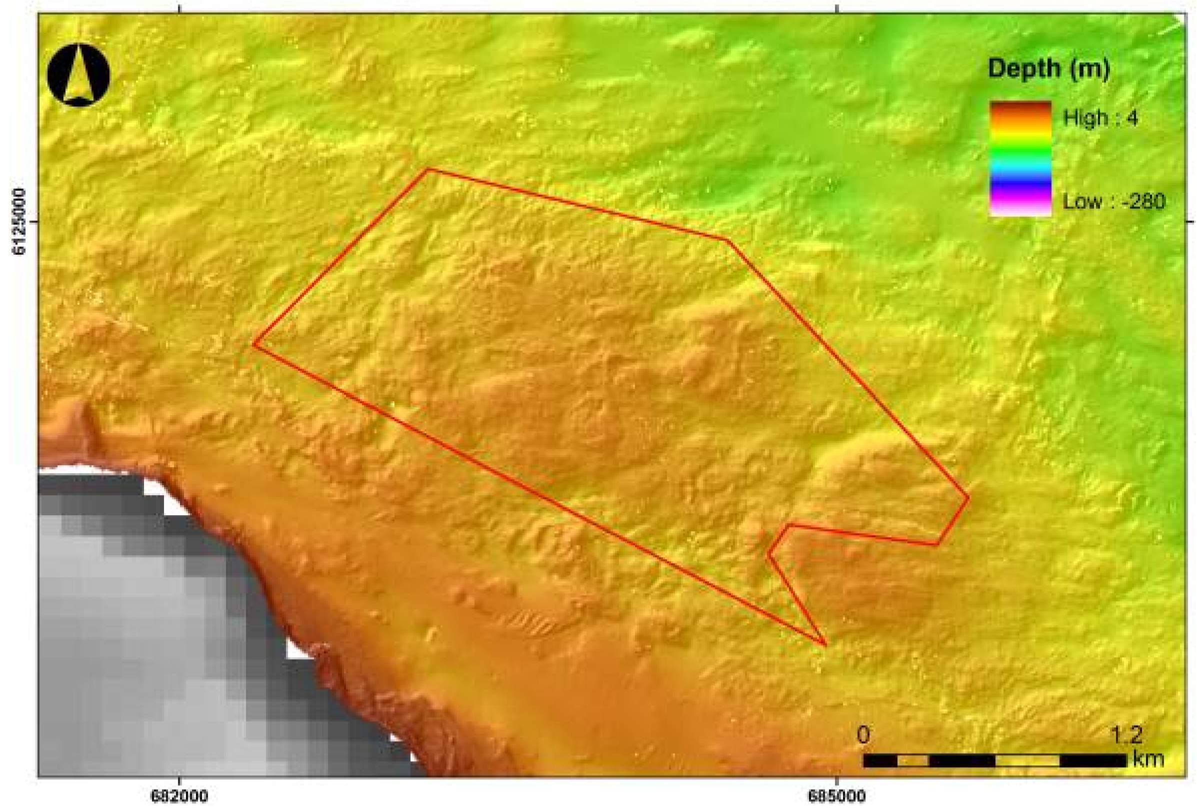


Figure 6.3: Detailed Bathymetric Map of the Study Area Derived from 4m-resolution JIBS data

The seabed off the North Eastern coast of Antrim falls very steeply along the shore to depths of approximately 30m. Between Fair Head and Torr Head the drop between the 30m and 50m contours is more gentle. From the 50m contour the gradient is approximately 0.45° towards the centre of the North Channel where depths of 315m exist. Bathymetric conditions are shown in further detail in Figure 6.3.

6.2.5 Tidal Conditions

The sea around Fair Head is noted for strong tidal forces, with variable and strong tidal currents producing a series of eddies at the interface of Rathlin Sound and the North Channel. Tidal currents in the open sea off the north coast of Ireland during mean spring tides are at their maximum in the area between Fair Head and mainland Scotland. The Atlas of UK Marine Renewable Energy Resources indicates that peak flow for a mean spring tide reaches more than 4 m/s across the potential array site, and peak flow for a mean neap tide reaches 1.5 m/s. The Atlas indicates that the mean spring tidal range across the site is 1 to 1.5 m (DTI, 2008).

6.2.6 Wind Conditions

Wind speeds along the north coast of Ireland exceed a value of between 3.5 m/s and 4 m/s for 75 per cent of the time. These values are mean hourly speeds and for shorter intervals the maximum speed is considerably greater (Buck, 1997). On the north coast of Ireland the dominant winds are from the west, southwest and south (Buck, 1997).

Figure 6.4 shows historical wind data, publicly available from windfinder.com, for the years 2006 to 2013 for a monitoring station at Ballypatrick Forrest roughly 4km south of Fair Head.

Month of year	Jan 01	Feb 02	Mar 03	Apr 04	May 05	Jun 06	Jul 07	Aug 08	Sep 09	Oct 10	Nov 11	Dec 12	SUM 1-12
Dominant Wind dir.													
Wind probability >= 4 Beaufort (%)	25	25	28	27	31	20	20	17	18	17	25	22	23
Average Wind speed (kts)	9	8	9	9	9	8	8	7	8	8	9	8	8
Average air temp. (°C)	5	5	6	8	11	13	15	14	13	10	7	5	9
Select month (Help)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year

Wind dir. distribution Ballycastle all year

© windfinder.com

Figure 6.4: Historical Wind Data

The average annual windspeed at 10m is roughly 4.11 m/s with a 23% exceedance probability of Beaufort scale 4 (5.5 – 7.9m/s).

6.2.7 Wave Conditions

The north coast of Ireland is in a high energy zone directly exposed to Atlantic storms and swells, with 75 per cent of wave power arriving from the west. The significant wave height exceeded for 10 per cent of the time around Rathlin is 1.5 m (Buck, 1997). Although Rathlin Island is very exposed to the Atlantic Ocean on its northwest coast, it has a relatively sheltered east coast.

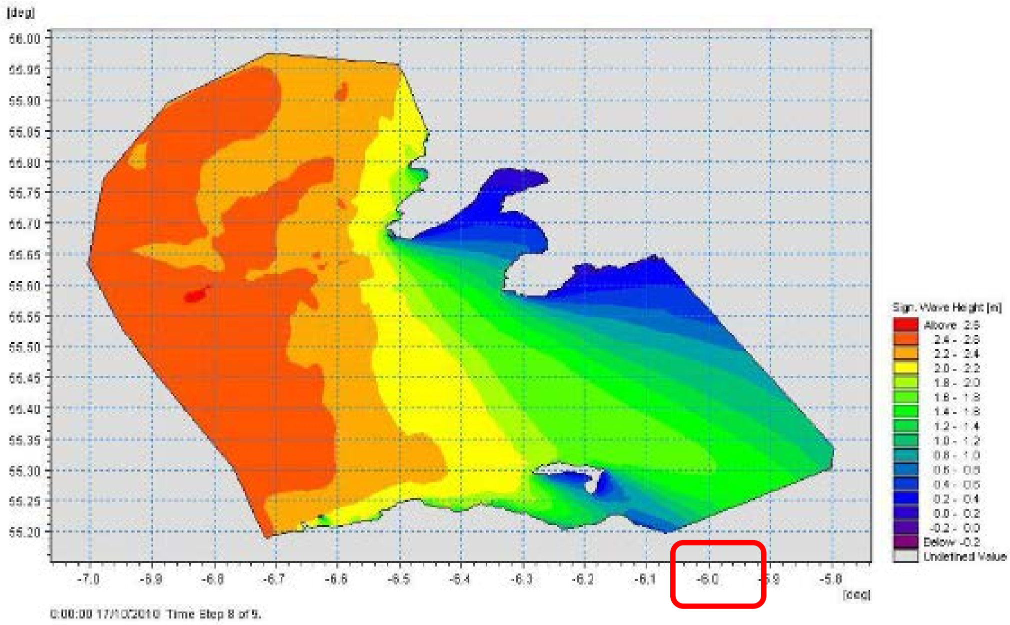


Figure 6.5 Screenshot of Metocean Model

Figure 6.5 above, an output from a FHTEP metocean model for the region, illustrates the expected wave regime at Fair Head as compared to more exposed sites on the west coast of Ireland and Scotland. Annual average significant wave height is expected to be between 0.6 and 1.2 m.

The ABPmer Atlas of Marine Renewable Energy Resources, figure 6.6, also illustrates the sheltering effects expected at Fair Head and predicts annual average significant wave heights of between 1.26 – 1.50m.

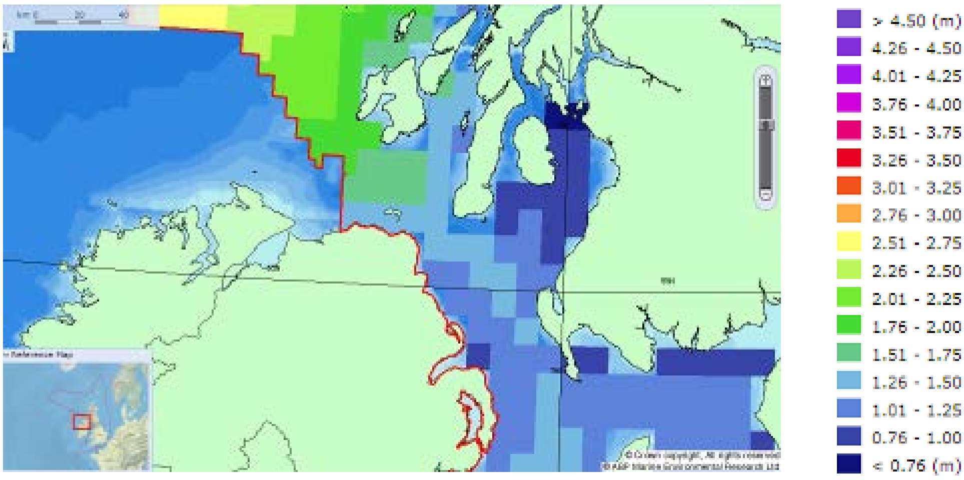


Figure 6.6: ABPmer Atlas of Marine Renewable Energy Resources

6.2.8 Designated Areas

There are several Earth Science Conservation Review (ESCR) sites on Rathlin Island and on the Antrim coast. These are locations of national earth science importance. Some of these sites are also designated as ASSIs or National Nature Reserves. Benthic Ecology. Designated areas are defined in Figure 8.1.

6.3 Potential Impacts – Marine Environment

Potential effects will be considered under each phase of the project.

6.3.1 Baseline Surveys

Any fine particles produced during grab samples or coring will be minuscule in the context of the size or the North Channel and will be quickly dispersed by the fast moving currents in the area.

6.3.2 Construction

The quantity of fine and/or coarse particles produced during foundation installation will depend on final foundation solution selected ie gravity bases or pinned bases. These are expected to be small given timescales predicted to install each foundation with risings from drilling operations being rapidly dispersed by the strong tidal currents. Cable burial may also give rise to some sediment generation but this is expected to be quickly dispersed by the strong tidal currents also.

6.3.3 Operation.

Coastal processes alteration may occur leading to changes in sediment transport resulting from modifications to tidal current flows adjacent to individual tidal devices. Impacts on sediment processes will depend on factors such as the design and size of the tidal energy array, size of the rotors, water depth and the height of the device above the seabed; these factors bear on the likelihood of seabed interactions.

The physical presence of an array of structures fixed to the sea bed has the potential to cause physical changes to the normal coastal processes. Potential alterations of sea bed bathymetry along the coast could result from changes to nearshore sedimentation bedforms such as sandbars and beaches as result of tidal current alteration and tidal energy reduction through absorption by the turbines. In this case, with structures that extend above the sea level, potential impacts on wave resources can also occur due to wave energy absorption, wave, refraction and diffraction. This could potentially lead to a reduction in wave resource in the area.

Scouring adjacent to foundations or buried or protected cables could be a feature of an installation. As these could jeopardise an installation regular maintenance inspection will be a feature of the scheme with corrective measures undertaken if and when required.

Alteration of the tidal currents as a result of increased friction or flow enhancement around each device or around the array is expected to be minimal. For example the Scottish Marine Renewables SEA reports that no gross alteration of the tidal stream is expected to result from the installation or operation of tidal energy devices.

It is envisaged that each device will be removed for maintenance / overhaul periodically, possibly every five years. As device is not yet selected the exact sequence cannot be described. Some devices, such as the MCT SeaGen device has a built in mechanism whereby the rotors and turbines can be raised above the surface for maintenance/removal.

6.3.4 De-commissioning.

No significant effects on seabed bathymetry, tidal currents, wind or wave conditions are predicted to result from decommissioning of the TEC array. The quantity of fine and/or coarse particles produced during foundation removal will depend on final foundation solution selected i.e. gravity bases or pinned bases. The sediment generated in the context of the size or the North Channel will be small and will be quickly dispersed by the fast moving currents in the area. Decommissioning of pinned foundations will normally involve infilling of the drilled pinholes following removal of the pins. This would be undertaken using inert rock materials.

6.4 Surveys for Marine Geology Scope and Methodology

The non-intrusive surveys undertaken as part of the EIA are designed to assess the sea bed conditions for both the tidal farm and subsea cable connection routes. They are designed to identify the likely methods of equipment installation (i.e.

drilling or piling and to what depths), and to enable an assessment of the likely environmental impacts these installation techniques might have on the surrounding environment. This will be undertaken in two phases:

6.4.1 Phase 1 – Desk Based Study

A study of existing data sources including the British Geological Survey (BGS) and JIBS database will be undertaken. It is envisaged this would expand on the BGS assessments already undertaken as part of the scoping exercise and review all available data which may be available from other sources such as the oil and gas industry or mineral extraction surveys.

6.4.2 Phase 2 – Geophysical Assessment

6.4.2.1 Multi-beam Echo Sounder

Swath and single beam bathymetry surveys will determine seabed topography and provide information on the relief of seabed structures. Measurements will cover the proposed site in a grid pattern using a main line of 75m. The cable route corridor will be surveyed in a centreline plus two wind lines at 75m intervals.

The echo sound data will be reduced to Lowest Astronomical Tide (LAT) using Admiralty Chart data. Reporting will consist of XYZ datasets which are processed using GIS software to produce an interpolated map of the bathymetry.

6.4.2.2 Side-scan Sonar

Sidescan sonar surveys will determine the nature of the seabed and any structures on it. In addition, it can provide information regarding the texture of the substrata within the site area which will then assist in the development of sediment transport modelling (section 6.6.1) and benthic communities (section 9.0). The survey will be carried out as per the echo sounder and presented with other appropriate data in GIS format.

6.4.2.3 Sub-bottom Profiling

Sub-bottom profiling surveys will determine the subsea bed geology and location of buried structures. Surveys will be undertaken in a grid pattern as per side-scan sonar and echo sounder for the tidal farm and along the centreline of the proposed cable connection corridor. Data will be stored digitally and presented in a GIS format.

6.4.2.4 Magnetometer

Magnetometer surveys will enable the position and nature of ferrous objects to be identified whether they are on the sea bed or buried beneath the sediment. Wrecks, archaeological features, cables and pipelines will be located using this technique. Surveying will take place as previous and the digital data recorded will be converted to GIS for presentation.

Data will be stored digitally including information about position and measured parameters. Based on the data provided, a seabed condition map will be created with a clear indication of specific soil areas and a specification of physical and chemical behaviour.

6.5 EIA Surveys for Coastal Processes Scope and Methodology

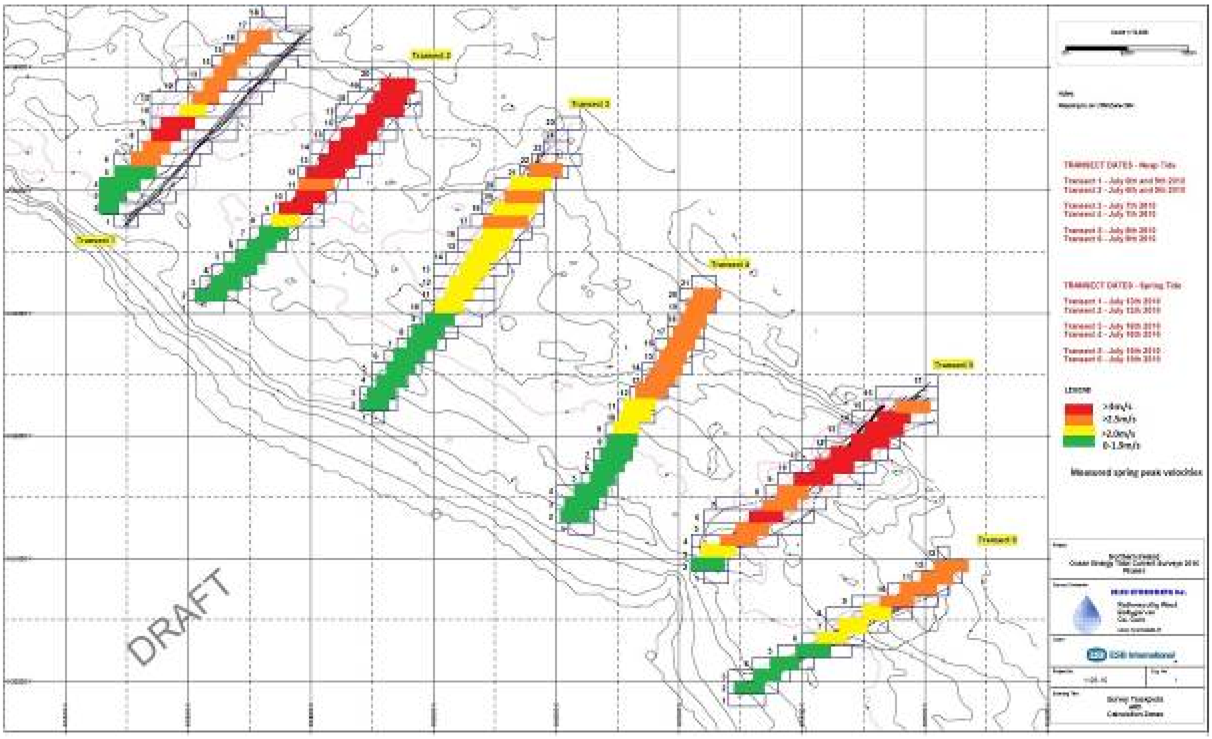
6.5.1 Metocean Data

A detailed metocean study will be undertaken to assess the marine environment, included in the works will be:

- Deployment of a buoy on site equipped with a standard meteorological suite to measure wind and wave conditions as well as rainfall and currents for a period of up to a year; and
- Defining a metocean model which will generate long term wind and wave statistics for the local area.

6.5.2 Tidal Conditions Data

Survey work has already undertaken utilising moving vessel transect ADCP works to confirm modelled predictions. A transect map showing the resource profile across the site is shown in Figure 6.7.



Data & Image Courtesy of ESBI

Figure 6.7 Estimate of Peak Spring Flows from July 2010 Transect Survey

The transect survey recorded depth averaged velocities exceeding 3.0m/s at some parts of the site.

In addition, a detailed mathematical model has been assembled and calibrated using measured data to predict annual yields, resource at specific locations and directionality of the flow over the flood and ebb tides (for neaps and springs). A screen shot of the model showing depth averaged velocity across the site can be seen in figure 6.8.

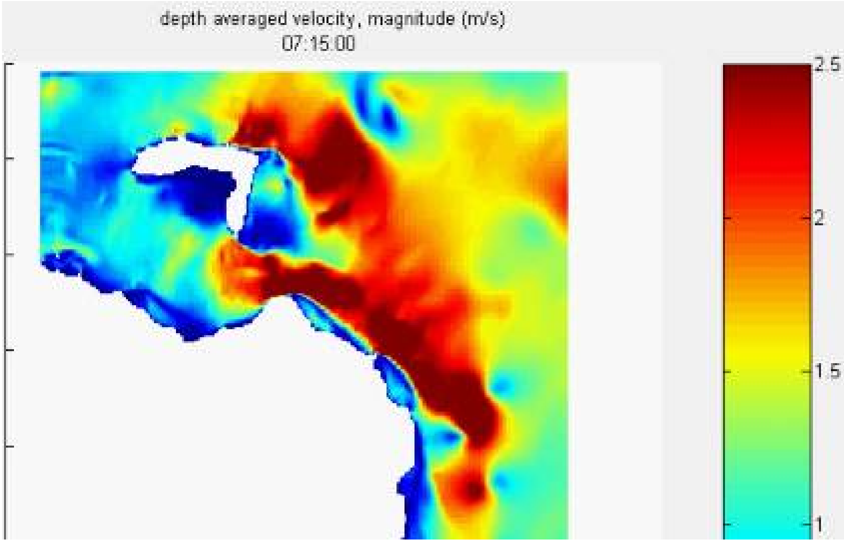


Figure 6.8: Hydrodynamic Model.

The hydrodynamic model provides information relating to the flow regime across the region with magnitudes and directions for a typical spring tide flood and ebb conditions shown in the vector plots in figures 6.9 and 6.10

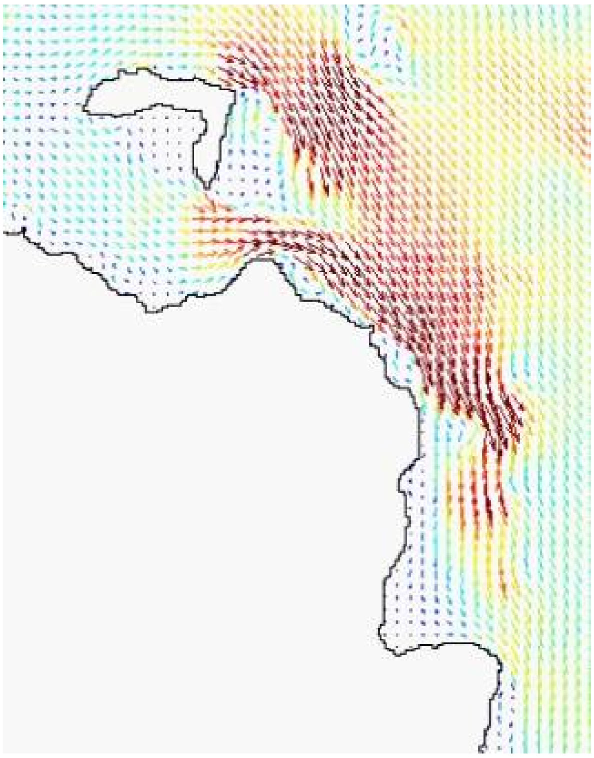


Figure 6.9: Vector Plot of Typical Peak Spring Flood Flow

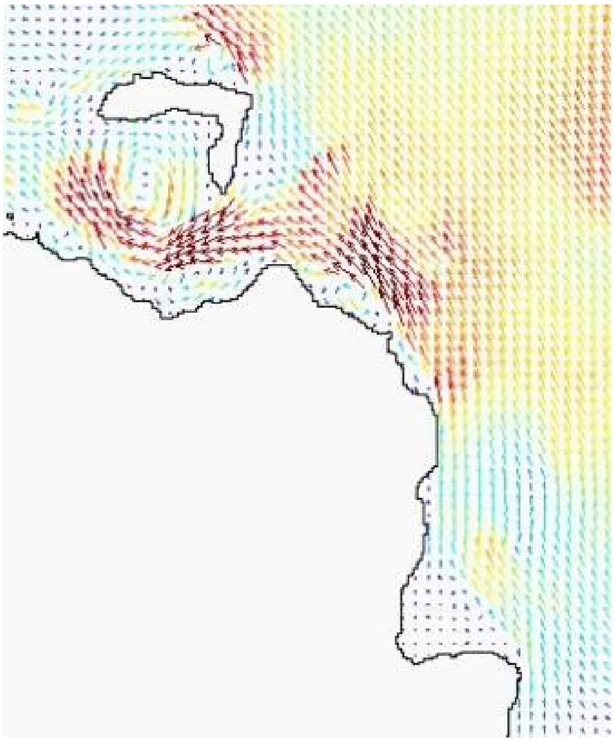


Figure 6.10: Vector Plot of Typical Peak Spring Ebb Flow

6.6 Sediment Processes

The potential impact on sediment processes can be sub-divided into near field and far field changes to the baseline condition. In the vicinity of the turbines there will be some local scour and changes in the local sediment transport pattern. The presence of the tidal energy farm could result in a decrease in marine energy affecting the overall sediment transport pattern and coastal morphology. In order to assess the current and future potential changes to the hydrodynamics and sediment dynamics the following data will be reviewed.

- Bathymetric data – single/multibeam echo sounder, side scan sonar, sub bottom profiles and grab samples;
- Sediment analysis from the benthic monitoring programme (section 6.2) including chemical/radioactive analysis;
- Current and historical seacharts and aerial photos to define changes in the shoreline and variations in the seabed profile;
- Coastal data – shore profiles, sediment data onshore and offshore; and
- Wind, wave and current data.

Due to the geological nature of the area with predominant rock and relatively little sediment as expected from a high energy scoured tidal zone and the fact that the predominant direction of current is perpendicular to the coastline it is not considered that a sediment transport model will be of value in this case. However, if following the geophysical review, a model is deemed necessary in consultation with relevant stakeholders it will be undertaken as defined in section 6.6.1 below.

6.6.1 Mathematical Modelling

Modelling is necessary to characterise the local and regional effects of the proposed development. Models will be constructed and calibrated to describe tide, current, waves, sediment transport and shoreline evolution for the North Channel and in the vicinity of the proposal in greater detail.

Mathematical modelling of hydrographical and sedimentary processes is integrated and consists of the following fundamental steps:

- Data preparation and analysis;
- Collection of available data from other sources;
- Preparation of data to calibrate and verify model;
- Statistical analysis of wind, tide, current and waves;
- Setup of hydrodynamic, wave and sediment model;
- Selection of calibration and verification periods;
- Model calibration and verification;
- Selection of scenarios to describe (normal year, storm year);
- Modelling of scenarios (different weather conditions, foundation types, layouts etc); and
- Presentation of modelling results.

6.7 Marine Geotechnical Surveys Scope and Methodology

The following is included for completeness since intrusive assessment surveys or geotechnical are solely conducted as part of the preconstruction micrositing and detailed design exercise not part of the EIA. They are intended to inform the micrositing of the turbines, and associated structures, and enable the detailed engineering design of each individual turbine base structure across the site.

6.7.1 Geotechnical Assessment

Following review of the geophysical data previously gathered, a geotechnical assessment programme is devised to identify exact locations where more intrusive sampling is required. The programme not only includes extraction of the subsurface material for study it also details a laboratory programme for the analysis of the physical and chemical characteristics of the erodable sediments and the strength and deformation parameters of the specific soils.

The assessment is undertaken in two steps:

6.7.1.1 Vibrocore and Cone Penetration Tests (CPT)

Vibrocoring is usually undertaken to a depth of 5-6m and CPT to maximum tip resistance/stop criteria. A penetration depth to a minimum of 20m is normally planned. During the CPT all observations are recorded and the soil cores from the vibrocoring are carefully cut, labelled and properly sealed in samples of around 1m in length. The samples can then be classified and reported.

6.7.1.2 Geotechnical Boring

Following the results of previous data from both non-intrusive and vibrocore and CPT, a geotechnical boring programme is devised to provide representative samples across the development site. During the boring, in-situ drilling tests are performed for the determination of the un-drained shear strength in cohesive soils (vane tests) and for the determination of the friction angle in non-cohesive soils.

Disturbed/remoulded samples go through simple classification tests whilst intact samples undergo more rigorous testing such as consolidation and tri-axial. Additional tests may include loss of ignition, carbonate content and Atterberg limits.

It is predicted that investigative drilling on site would be to a depth of approximately 15 - 20m below seabed.

6.8 Onshore Geology, Hydrology and Hydrogeology Scope and Methodology

The assessment will be based upon the landfall cable corridor and the potential area for the substation/control room (to include the access track), and the catchments down stream of these locations where there may be a potential effect.

Onshore geology, hydrogeology and hydrology are closely linked aspects of the environmental assessment, with the possibility of common effects. For the purposes of the assessment, geology is considered to include bedrock, mineral soil, peat and drift deposits; hydrogeology and hydrology include groundwater and surface water.

The identification of effects and impacts will be carried out by requesting the relevant soil data from The Macaulay Institute and Geological data and British Geological Survey. Confirmation of the site baseline data will take place during a walkover survey following an initial desktop study. Details of private water supplies and the location and nature of these will also be confirmed during the walkover survey. Typical hydrological characteristics of the catchments that the site lies within will be sought and the catchment flow volumes calculated from the Flood Estimation Handbook (1999).

The assessment will provide baseline information, identify potential impacts based on the magnitude of the impact and the sensitivity of the site. Mitigation proposals where appropriate will be made followed by an assessment of the significance of any residual impacts.

7.0 Contamination and Water Quality

7.1 Introduction

This section considers the potential effects of the proposed development on water and sediment quality in the study area. In addition to direct effects there is also a potential for secondary effects on ecosystems. This latter effect is discussed further in chapter 9 on Benthic.

7.2 Current Knowledge

There are several directives associated with the targeted reduction of discharges to the coastal waters. However, one of the most far reaching, The Water Framework Directive (2000/60/EEC) only extends to 1nm and therefore does not cover the entire Development Area.

NIEA and DoE MD, in their role of implementing the Water Framework Directive 2009-2015, are responsible for the water quality on the land and coastal area adjacent to the proposed site. These plans and responsibilities are defined in the North Eastern River Basin Management Plan as published in December 2009. The plan contains the current or baseline evaluation / classification of the land and coastal waters in the area under consideration and identifies locations for future monitoring. The project sits within the North Channel Coastal water body, UKGBNI6NE030, which is 141.9km2 in size. This water body has been classed as Good for ecological status and Pass for Chemical Status in the 2009 Plan. The overall water body classification is classified as good.

The UK National Marine Monitoring Programme (NMMP) now Clean Seas Environment Monitoring Programme was established to provide a coordinated approach to environmental monitoring in coastal and estuarine areas. The programme brings together the statutory marine monitoring agencies throughout the UK around the need to provide reliable and harmonised information for the UK coastal area. This programme has two monitoring locations relatively close to the proposed site (Site 875 North Antrim Coast and Site 865 North Channel NC2). These two offshore stations are maintained by AFBI and may act as reference stations for assessing contaminant trends. This work will largely be subsumed by the Marine Strategy Directive –see below.

7.2.1 Marine Framework Strategy Directive

In June 2008 the European Marine Framework Strategy Directive (MFSD) was adopted. The objective of the directive is to enable the sustainable use of marine goods and services and to ensure the marine environment is safeguarded for the use of future generations. In achieving this objective the MSFD requires Member States to 'take the necessary measures to achieve or maintain good environmental status (GES) of the marine environment by 2020 at the latest'. The MSFD extends and builds on the requirements of the Water Framework Directive (WFD) into seas beyond the current WFD limit.

7.2.2 Marine and Coastal Access Act 2009

Through the Marine and Coastal Access Act 2009, the UK-wide Marine Policy Statement was prepared by all the Administrations. This document, which applies to all UK marine waters, came into effect in March 2011. It sets out the key strategic priorities for the UK's marine waters and is a tangible product against which all sustainable licensing decisions will be made until such times as marine plans are in place.

7.2.3 Water Quality & Contamination

The NI SEA summarises the current situation as follows. The main sources of contamination to the waters of the study area are some distance away. Any contaminants in Northern Ireland’s water are therefore considerably diluted, compared to the main source areas, centred on the highly populated industrial centres of the North West of England and the Clyde. In addition there has been a marked decrease in inputs from these areas over the latter part of the 20th Century. Therefore, while there is evidence for increases in contaminant concentration with the decreasing influence of North Atlantic Water, there are no offshore sites which approached Environmental Quality Standard concentrations.

7.2.4 Bathing Waters

In Northern Ireland bathing waters were initially identified under the EC Bathing Waters Directive 1976 and are now protected under the new bathing waters Directive 2006/60/EC which has been introduced through the Quality of Bathing waters (Northern Ireland) Regulations 2008. This new Directive replaces the 1976 Directive and requires a first classification of bathing water quality under Article 4 of the Directive to be carried out by 2015.

A total of 24 sites were identified under the 1976 EC Bathing Water Directive and monitoring has been in place since 1988. Bathing beaches to the north and south of the proposed site are grouped into the North Antrim Coast and include, Ballycastle, Waterfoot, Carnlough, Ballygally and Brown’s Bay.

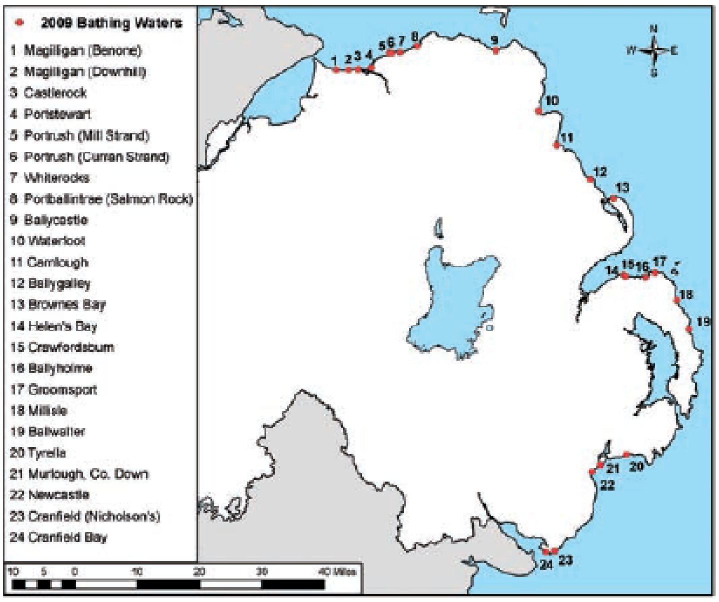


Figure 7.1 Northern Irelands Identified Bathing Waters

All bathing waters were classified as good / excellent for the 2009 bathing season although isolated incidents of water quality failure occurred on single occasions at Waterfoot, Ballygally and Brown's Bay (Figure 7.2).

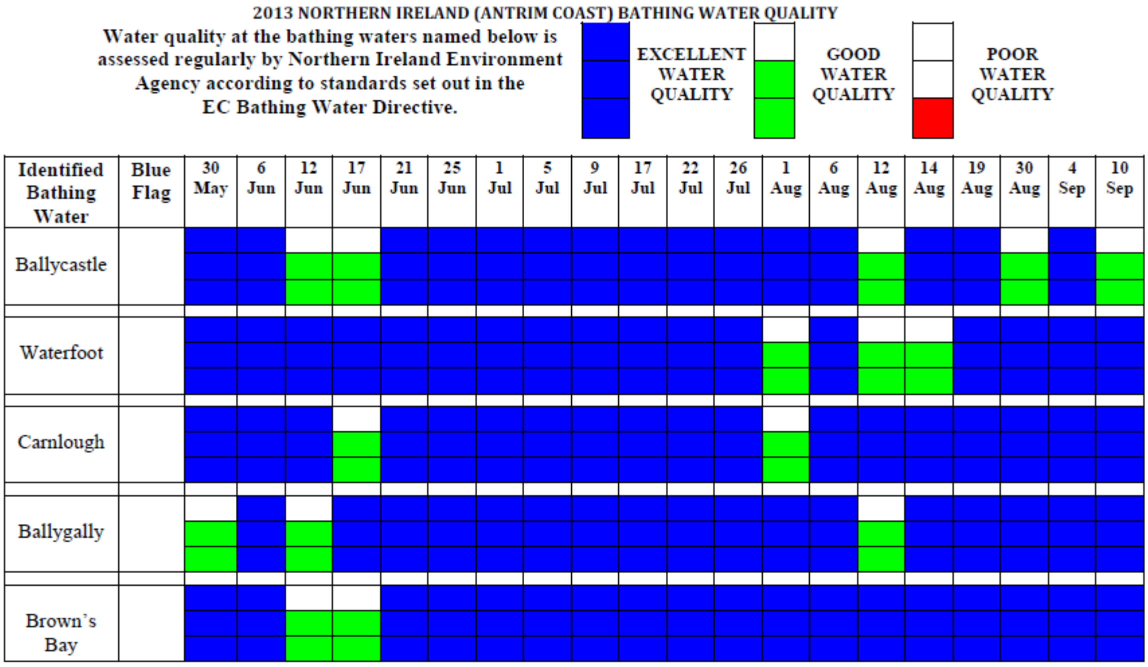


Figure 7.2 Antrim Coast Bathing water quality 2013.

7.2.5 Shellfish Waters

The Shellfish Waters Directive (2006/113/EC) aims to protect and where necessary improve the quality of coastal and brackish water bodies in which shellfish live and grow, in order to contribute to the quality of edible shellfish products. This Directive replaced the earlier Directive 79/923/EEC but maintains all existing measures relating to the standards for the quality of designated waters and requirement for Member States to monitor the quality of the waters and to take measures to ensure that they comply with the minimum standards.

DoE Marine Division is responsible for ensuring compliance with the Shellfish Waters Directive. The Department has now classified new or modified existing areas by means of a Legal Notice under Article 6 of the Water (Northern Ireland) Order 1999. There are now 10 shellfish waters in Northern Ireland.

The Shellfish Waters Directive is not intended on its own to protect the quality of shellfish for consumption. This element is controlled by the Food Standards Agency through a number of consolidated food hygiene regulations (EC) 852/2004 (EC) 853/2004 and (EC) 854/2004 .

The Food Standards Agency (FSA) has consistently classified all of the Northern Irish Shellfish waters as either Class A (shellfish suitable for human consumption) or Class B (suitable for human consumption after a period of cleansing) (FSA 2009). While these classifications are based on the levels of pathogenic organisms in shellfish from the sites they are an indicator that there is a low level of contamination at such sites. There are currently no classified beds in the vicinity of the site.

7.3 Potential Impacts

Potential effects on water quality can be considered under each phase of the project.

7.3.1 Baseline Surveys

- Fine particles or sediments generated or disturbed during coring operations could give rise to impacts on benthic communities. However, any fine particles produced during coring operations will be minuscule in the context of the size of the North Channel and will be quickly dispersed by the fast moving currents in the area;
- Possible release of oil pollution in water from surveying vessels. Vessels used, most likely, will be local fishing vessels who normally fish in the general area. Only vessels complying with current regulations and certified will be employed; and
- Disturbance of contaminated sediments.

7.3.2 Construction

- Potential increase in suspended sediments in the water column due to construction operations such as foundation spoil/cuttings from piling and cable laying. The risings and the potential for impact will depend on final foundation solution selected i.e. gravity bases or pinned bases. It is likely that the quantity of risings will be small in the context of the size of the North Channel and also likely they would be quickly dispersed by the fast moving currents in the area;
- Potential release of increased radioactivity/contaminant inherent in rock strata or seabed if drilling of foundations is required;
- Release of grout into the water column if used as part of pile design;
- Leaks / spill of oils or lubricants form installation vessels could potentially cause some adverse effect if not controlled;
- Releases from newly painted / protective coating applied to turbines and their supporting structures;
- Disturbance of contaminated sediments; and
- Indirect effects of increased suspended sediment on water quality, benthic and fish ecology could occur during the construction phase and could potentially result in smothering of benthic communities and increased turbidity leading to impacts on fish and algal (corraline algae) ecology. The extent of these effects will be determined largely by the choice of foundation method chosen, piled foundations may produce higher levels of sediment compared to moored foundations The nature of the seabed and likely characteristics of the risings will also influence the extent of likely impact as well the sensitivity of the receptor in the area. AFBI and DOE have developed protocols for reactive monitoring of sediment arising from dredging activity, and it would be expected that a similar method could be applied if appropriate.

7.3.3 Operation and Maintenance

- Leaks / spill of oils, lubricants or antifouling coatings from inspection / maintenance vessels could potentially cause some adverse effect if not controlled;
- Leaks of lubricants from turbine units during operation;
- Scouring, producing sediments adjacent to foundations or buried or protected cables could be a feature of installations. Regular maintenance inspections will be a feature of the scheme with corrective measures undertaken if and when required; and
- It is envisaged that each device will be removed for maintenance / overhaul periodically, possibly every five years. In general the potential effects would be much less than those experienced during installation as the foundation elements of the installation would not be involved.

7.3.4 De-commissioning.

- Increased quantity of fine and/or coarse particles produced during foundation removal, this will depend on final foundation solution selected i.e. gravity bases or pinned bases. In the context of the North Channel they will be quickly dispersed by the fast moving currents; and
- Leaks / spill of oils or lubricants from decommission vessels could potentially cause some adverse effect if not controlled.

7.4 Scope and Methodology of Impact Assessment

The baseline status of the Water Quality will be fully investigated as part of the design and EIA process. This will involve both desk based reviews and survey / modelling work.

7.4.1 Desk Based Reviews.

- Review of all national, regional and local policies relating to terrestrial and coastal waters;
- Collection of all available data on water quality; and
- Consultation with DoE MD regarding baseline data and requirements for any additional data.

7.4.2 Survey Work

Data from vibro-core sampling undertaken to characterise the sea bed conditions will provide information on particle grain size and levels of contamination of substrate. This will provide a characterisation of the likely arisings. These data will feed into the coastal process modelling described in Section 6.5 above. This will provide a map of the potential impact areas of any arisings from construction and decommissioning. The model will also be used to predict the contribution of arisings to water quality baseline conditions for suspended matter, turbidity and water clarity and from any contaminated sediments. *In situ* instrumentation can be put in place to ensure limits predicted by modelling are not exceeded.

7.4.3 Monitoring Methodology

It is considered that operational activities may require to be monitored. AFBI previously utilised real-time "alert" monitoring systems to meet these objectives.

An environmental monitoring plan will be developed which includes benthic monitoring and ongoing assessment to monitor the health of key commercial species. These programmes will be discussed and agreed with relevant consultees following identification of potential impacts and appropriate mitigation measures.

7.5 Mitigation

Mitigation measures will evolve as the EIA process is undertaken but based on current knowledge these will include the following:

- Implementation of Health and Safety Plan and Environmental Management Plan during Construction, Operation and De-commissioning to eliminate the potential for accidental release of any material from devices or the vessels involved in the project;
- Use of biodegradeable oils and hydraulic fluids should be considered where appropriate;
- Use of non toxic anti-fouling paints on foundation structures and bodies of units;
- Implementation of an Environmental Management System; and
- Ensuring all waste disposal is by means licensed waste management contractors and facilities onshore as required.

Section 3: Biological Environment

Protected Sites and Species

Photographer -
Kathleen McNeilly

8.0 Protected Sites and Species

8.1 Baseline Conditions / Current Knowledge

In identifying protected sites within or adjacent to the proposed array site the following data sources have been used:

- World Heritage Sites (United National Educational Scientific and Cultural Organisation);
- Existing and proposed protected sites, Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Areas of Special Scientific Interest (ASSIs), Ramsar Sites, Marine Conservation Zones (MCZ)s, National Nature Reserves (NNRs) and Areas of Outstanding Natural Beauty (AONB));
- SEA of Offshore Wind and Marine Renewable Energy in Northern Ireland;
- Northern Ireland Environment Agency (NIEA);
- Consultation with NIEA officers;
- Joint Nature Conservation Committee (JNCC) database;
- NIEA Protected areas and biodiversity pages (NIEA 2009a and 2009b);
- Report from WWF and Ulster Wildlife Trust on marine reserves in Northern Ireland (Thurston et al. 2008); and
- WFD Register of Protected Areas.

Figure 8.1 shows the proposed array site in relation to North Antrim and the various environmental designations in the area.

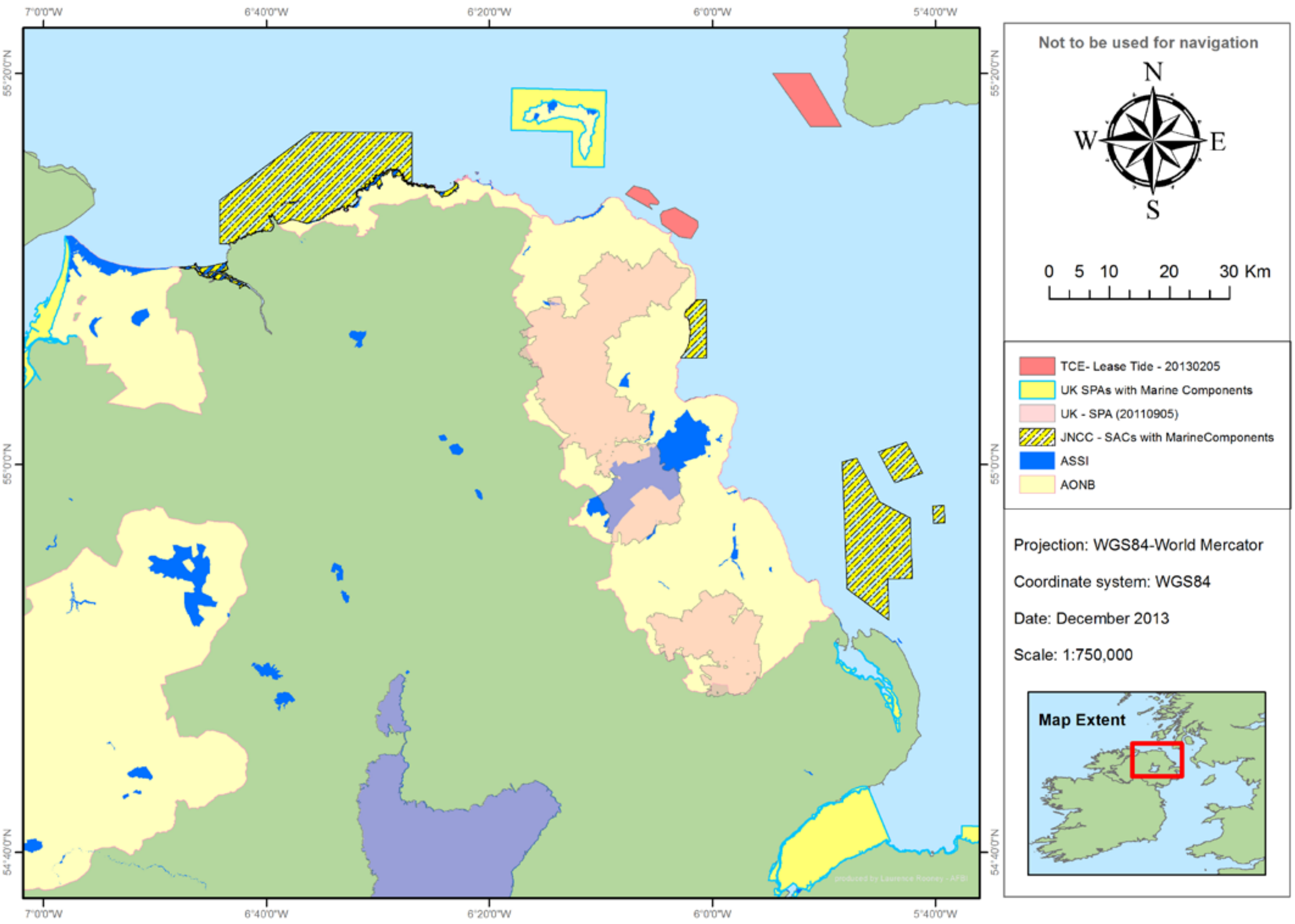


Figure 8.1 Environmental Designations

Designated areas in the vicinity of the area of interest are listed in Table 8.1.

With reference to Appendix B of the NI SEA, around 80 sites within the study area (Northern Ireland territorial waters from mean high water mark seaward to 12nm) have been designated under International, European and National levels of importance.

Name	Designation	Feature
North Antrim Coast	World Heritage Site (United Nations Educational, Scientific and Cultural Organisation (UNESCO)), and SAC (UK0030224) http://whc.unesco.org/en/list/369	The Giants Causeway and Causeway Coast site is of outstanding universal value representing an outstanding example of major stages of the earth`s history. It also contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance. The coast has also been designated an SAC with vegetated sea cliffs, salt meadows, shifting and fixed dunes and grassland. Under annex II the coast supports the only known living population of narrow-mouthed whorl snail in Northern Ireland.
Rathlin Island	SPA (UK9020101) and SAC (UK0030055) ASSI	http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUCode=UK0030055
Skerries and Causeway	cSAC	http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUCode=UK0030383
Red Bay	SAC (UK0030365)	http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUCode=UK0030365
Maidens	cSAC UK0030384	http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUCode=UK0030384
Sheep Island	SPA (UK9020021)	Regularly supports, in summer, a nationally important breeding population of the Northern European Sub-species of Cormorant (5% of the British Isles breeding population and 7% of the Irish breeding population). In addition the population is the largest in the North of Ireland and thus makes an important contribution to the range of the Sub-species.
Garron Plateau	SAC	http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUCode=UK0016606
Ailsa Craig	SPA (UK9003091)	http://jncc.defra.gov.uk/default.aspx?page=1949
Torr Head	ASSIhttp://www.doeni.gov.uk/niea/protected_areas_home/new_assi_landing_page/county_antrim-2/torr_head_assi.htm	Torr Head is the best exposure of metamorphosed Limestone of Dalradian age in Northern Ireland. Torr Head is the type locality for the Torr Head (Limestone) Formation. The site is of international importance as it is crucial in aiding the understanding of the relationships between rock sequences elsewhere in Northern Ireland and Scotland.
The Ballycastle Coalfields,	ASSIhttp://www.doeni.gov.uk/niea/protected_areas_home/new_assi_landing_page/county_antrim-2/ballycastle_coalfield_assi.htm	Ballycastle Coalfield is the best exposure of a coalfield sequence in Ireland. It contains a series of Carboniferous sedimentary rocks (335-330 million years old) with contemporary lavas and younger Tertiary igneous rocks (60 M.y.). The sedimentary rocks were deposited in a shallow marine bay which gradually developed into a vegetated coastal swamp subject to periodic flooding by the sea. The vegetation was preserved as seams of coal. Fossils that have been found include goniatites (shellfish), fish remains, giant clubmosses and arthropod insects. The Tertiary dykes have metamorphosed the carboniferous shales to produce porcellanite and a range of minerals. The site also contains evidence of early industrial activity: the coals and iron ores were mined between the 16th and 19th centuries. The underlying geology and the spoil heaps give rise to both base rich and acidic habitats, including wet grassland, base-rich flushes and maritime

Name	Designation	Feature
		heath. Limited saltmarsh occurs on some of the beaches.
Giants Causeway,	ASSI http://www.doeni.gov.uk/niea/protected_areas_home/new_assi_landing_page/county_antrim-2/giants_causeway_and_dunseverick_assi.htm	The Giant's Causeway is the most renowned geological site in Northern Ireland and has a truly international reputation. It is particularly important for its role in early debates on the origin of igneous rocks and is famous for its columnar basalts and associated materials. In addition, the Causeway Coast has representative Lower, Interbasaltic and Upper Basalt Formations relating to the three main eruption series in the Atlantic Ocean between 53-65 million years ago. The area is also important for its Zeolite mineralogy. The Causeway area is notable for its maritime cliff communities and also includes wet and dry heath, and species-rich grasslands. Closer to the shore, plant communities include saltmarsh and fen. The coast is also important for intertidal communities. A number of notable plant species have been recorded. These include oysterplant, a notable shoreline species and saltmarsh flat-sedge. This diverse site supports a rich invertebrate assemblage with a number of notable species, including snails, craneflies and weevils. Both breeding and wintering birds are also important for the site, with significant populations of breeding fulmar and black guillemot.
Rathlin Island,	ASSI http://www.doeni.gov.uk/niea/protected_areas_home/new_assi_landing_page/county_antrim-2/rathlin_island_-_coast_assi.htm	The coastal ASSI is of particular interest because of the wide variety of habitats and associated flora and fauna. These habitats include features such as high isolated sea cliffs and sea stacks, maritime grassland, saltmarsh areas and a wide range of intertidal features. These formations include vertical cliffs and shores of both boulder and shingle. There are also wave cut platforms on both chalk and basalt. The geological exposures of columnar basalt rock and other physical formations associated with such coastal conditions are also of importance. In summer, the sea cliffs and sea stacks provide nesting sites for a variety of species of seabirds. There are three species of seabird whose numbers reach internationally important numbers. These are guillemots, razorbills and kittiwakes and Northern Ireland's largest population of puffin breed among the grassy slopes of the cliff ledges. A small colony of Manx shearwater, an Annex I species, has also been noted in the ASSI. Other species that are important in an all-Ireland context include an unusually high density of raptors. The raptors use the cliffs as nesting sites and species present include the Peregrine falcon and the buzzard.One pair of chough has also bred there in recent years. The caves and rocks around the shoreline of the ASSI are used by grey seals as haul outs and resting sites.
White Park Bay	ASSIhttp://www.doeni.gov.uk/niea/protected_areas_home/new_assi_landing_page/county_antrim-2/white_park_bay_assi.htm	Situated on the north coast of Co. Antrim, White Park Bay faces north and lies between Port Braddan about 2 km east of Dunseverick Castle, and Dundriff a further 2 km to the east. The area covers 87.74 ha and extends some 400m inland, and has the mean low tide mark as its seaward boundary. The bay comprises a massive land-slipped area backed by high chalk cliffs. Several exposures are well represented, with sea-stacks and natural arches present. In addition, White Park Bay is notable for its diverse plant and animal communities, its largely, unmodified nature and the number of rare plants and animals recorded. Common lizard and Pygmy shrew are recorded from the site. Rabbits play an important role in grazing grassland areas. There have been occasional strandings of cetaceans, and grey seals sometimes haul out on off-shore rocks.
Giants Causeway	National Nature Reserve	Within the nature reserve, a series of paths run between the visitor centre and Hamiltons Seat providing views of the Amphitheatre, the Chimney Tops, the Giants Causeyway itself and Port-na-Spaniagh, where the Spanish

Name	Designation	Feature
		galleon "Girona" sank in 1588.
Kebble	National Nature Reserve	The reserve is located on Rathlin Island and is best known for its assemblage of breeding birds, Guillemots, razorbills, kittiwakes and fulmars. Peregrine falcons, buzzards and ravens also build nests on the cliff ledges.
Antrim Coast and Glens	Area of Outstanding Natural Beauty	The coastline from Ballycastle to Larne and the world famous Glens of Antrim contain some of the most beautiful and varied scenery in Northern Ireland. The area is dominated by a high undulating plateau cut by deep glens which open north and eastwards to the sea.
Causeway Coast	Area of Outstanding Natural Beauty	The Causeway coast boasts the only World Heritage Site in Northern Ireland. It encompasses 18 miles of spectacular coastal scenery with dramatic cliffs and headlands broken down by the wide sweep of sandy beaches backed by dunes.

Table 8.1: Designated Areas Around the Area of Interest.

8.1.1 Special Areas of Conservation (SACs)

SACs are designated sites under the EU Habitats Directive (92/43/EEC), for the conservation of natural habitats and of wild fauna and flora of European importance. SACs and SPAs make up the Natura 2000 (N2K) network. Two candidate SACs are also included as DOE Marine Division will consider these as fully designated for the purposes of licensing decisions.

Information provided on the JNCC website on SACs in Northern Ireland indicates that the closest sites with this designation are Rathlin Island (EU Site Code – UK0030055) and Red Bay (UK0030365)

8.1.1.1 Rathlin

The general site character for Rathlin indicates Marine areas and Sea inlets (93%) with Shingle, Sea cliffs and Islets (7%). The primary designation relates to reefs (1170), Vegetated sea cliffs of the Atlantic and Baltic Coasts (1230) and submerged or partially submerged sea caves (8330).

Rathlin Island is surrounded by a wide range of rocky habitats and is one of the best examples of reefs in Northern Ireland. Strong tidal streams prevail around most of the island, and there is little silt. As a result, turbidity is generally low, with the infralittoral extending below 20m depth, and water temperatures are stable, not rising much above 13ºC in the summer. A very wide range of species has been recorded around the island, including a high proportion of species of particular interest including oaten pipes hydroid *Tubelaria indivisa* in deeper water and by a diverse assemblage of algae in the shallows. A number of species occur that are rare in Northern Ireland, especially those with south-western distributions, such as the sea-cucumber *Holothuria forskali*, the sponge *Axinella damicornis*, and the red alga *Drachiella spectabilis*. The northwest part of Rathlin Island consists of a shallow shelf 10-100 m wide along the base of the cliffs, followed by a vertical underwater cliff which starts at 20-30 m and descends to over 100 m. The cliffs are formed of both limestone and basalt, and support a rich assemblage of sponges and hydroids. Dominant species include the sponge *Pachymatisma johnstonia*, the soft coral *Alcyonium digitatum*, *Dendrodoa grossularia* and *T. indivisa*. To the north-east, the slope offshore is shallower, with the seabed consisting of areas of bedrock interspersed with stable boulder slopes. Sponges are particularly diverse and abundant. In shallow water there are overhangs and surge gullies with characteristic assemblages of species. The circalittoral zone of the east coast is mostly dominated by rich hydroid and sponge-dominated biotopes on bedrock, boulders, and cobbles, amongst coarse gravel. Frequent components of these biotopes are the hydroids *Polyplumaria flabellata*, *Diphasia alata* and the sponge *Axinella infundibuliformis*.

Rathlin Island represents an extensive area of hard cliff along the exposed northern coastline of Northern Ireland. The site exhibits contrasting geology, with Cretaceous chalk overlain by Tertiary basalts. The site consists of very high vertical sea cliffs and sea stacks to the north and east, with more gentle slopes on the eastern coast. As a result of these variations in height and slope, in addition to the diversity of aspects, exposure and rock type, a wide range of maritime cliff vegetation communities is present. Red fescue *Festuca rubra* is often the dominant species in the grassland communities, while heath is also present in some places. Some species recorded for the site are scarce in Northern Ireland, including common juniper *Juniperus communis*, Scots lovage *Ligusticum scoticum* and roseroot *Sedum rosea*.

Rathlin, includes well-developed examples of both partially submerged and submerged caves and overhangs in limestone and basalt in a strong tidal stream. Submerged caves occur mainly at depths ranging from 20 to over 100 m. The site has a rich assemblage of sponges and hydroids. Species found include sponges such as *Stryphnus ponderosus* and *Dercitus bucklandi*, and the anemones *Sagartia elegans*, *Parazoanthus axinellae* and *P. anguicomus*, which are frequent. The site is used by cave-breeding 1364 Grey seal *Halichoerus grypus*.

8.1.1.2 Skerries and Causeway

This site of the North Antrim Coast is selected for both benthic habitats:

- Sandbanks which are slightly covered by sea water all the time for which this is considered to be one of the best areas in the United Kingdom.
- Reefs for which this is considered to be one of the best areas in the United Kingdom. Plus submerged or partially submerged sea caves. It is also selected for the cetacean *Phocoena phocoena* or harbour porpoise.

8.1.1.3 Red Bay UK0030365

The Red Bay site is located off the County Antrim village of Cushendun, Northern Ireland. It contains Annex I Sandbanks slightly covered by seawater at all times which are composed of maerl, sub-fossil maerl, coarse sands, gravels and cobbles. The sand bank is comprised of relic drowned drumlins from the last ice-age ca 15000 yr BP. The Red Bay sandbanks are dominated by both living maerl and sub-fossil maerl and have been thoroughly mapped and characterised as part of this SAC selection assessment. Unique to this site is the presence of large 2-3m high mega-ripples of sub-fossil maerl. These mega-ripples are comprised of maerl, gravel and sands on the crests, and cobbles and globular sub-fossil maerl in the troughs, with occasional sand patches on the slopes.

8.1.1.4 The Maidens UK0030384

Sandbanks which are slightly covered by sea water all the time for which this is considered to be one of the best areas in the United Kingdom.

Reefs for which this is considered to be one of the best areas in the United Kingdom. *Halichoerus grypus* for which the area is considered to support a significant presence.

This area is relatively undisturbed at present however it will need appropriate management for any future uses, such as mobile fishing gear that can exploit reef areas such as rock-hopper trawls and tangle nets as well as its identification as a potential tidal energy site and any impacts of diffuse or point-source pollution and marine development.

8.1.1.5 Other

The North Antrim Coast from west of the Giant's Causeway to the east end of White Park Bay is also an SAC, (North Antrim Coast EU Site Code – UK0030224). The primary reason for designation of this site is the presence of Annex I Habit Vegetated sea cliffs of the Atlantic and Baltic Coasts. The North Antrim Coast represents an extensive area of hard cliff along one of the most exposed coastlines in Northern Ireland. The site exhibits contrasting geology. The western part is centred on the Giant's Causeway with its geochemically alkali and intermediate basaltic high cliff, interspersed with a series of coves. The eastern section hosts the limited active and extensive fossil chalk sea-cliffs. The basalt series supports a range of communities including those associated with rock crevices and cliff ledges, and with a range of typical maritime grasslands and heath. Notable species for the site include Wilson's filmy-fern *Hymenophyllum wilsonii*, thyme broomrape *Orobanche alba*, hare's-foot clover *Trifolium arvense*, zigzag clover *Trifolium medium* and common juniper *Juniperus communis*. The chalk cliffs support mesotrophic and calcareous grasslands.

The North Antrim coast supports the only known living population of the narrow toothed Whorl snail *Vertigo angustior* in Northern Ireland. Two populations have been identified in tall, lightly grazed damp grassland.

Other SAC designated area in County Antrim include Breen Wood (EU Site Code UK0030097, Garron Plateau (SAC EU Code –UK 0016606 and Garry Bog (EU Site Code – UK0016610, Main Valley Bogs (EU Site Code – UK 0030199), Rea's Wood and Farr's Bay (EU Site Code – UK0030244, Montiagh's Moss (EU Site Code –UK 0030214) andBann Estuary (SAC EU Code UK 0030084)

When undertaking an appropriate assessment of impacts at a site, all features of European importance (both primary and non-primary) need to be considered.

8.1.2 Special Protection Areas (SPAs)

These are European designated sites, under the Birds Directive (79/409/EEC), for the conservation birds. SPAs with marine components are defined as those sites with qualifying Birds Directive Annex I species or regularly occurring migratory species that are dependent on the marine environment for all or part of their lifecycle, where these species are found in association with intertidal or subtidal habitats.

Rathlin Island SPA (EU Code UK9020011): The JNCC description of Rathlin Island SPA indicates that it supports an important breeding assemblage of seabirds, especially including auk and gull species. Large numbers of Peregrine Falcon *Falco peregrinus* also nest on the cliffs. The area regularly supports some 66,000 individual seabirds during the breeding season. including: Puffin *Fratercula arctica*, Kittiwake *Rissa tridactyla*, Herring Gull *Larus argentatus*, Lesser Black-backed Gull *Larus fuscus*, Common Gull *Larus canus*, Fulmar *Fulmarus glacialis*, Razorbill *Alca torda*, Guillemot *Uria aalge*. Although the SPA supports a substantial marine area, the seabirds also feed outside the SPA in surrounding marine areas.

Sheep island SPA (EU Code UK9020021): Sheep Island is a small, exposed island with steep cliffs and rocky shores, located off the north Antrim coast and holds a breeding colony of Cormorant *Phalacrocorax Carbo carbo*.

The Antrim Hills site comprises two land units. The northern, larger, section extends between Carnanmore and Soarne's Hill, including Ballypatrick Forest, Slieveanorra Forest/Breen Wood and Glenariff/Cleggan Forest, mainly including land above the 220m contour. The southern section comprises the area bounded by Capanagh, Ballyboley and Douglas Top. Both sections are delimited principally by physical boundaries closest to merged radii extending 2.5km from nest sites used by Hen Harriers between 1997 and 2004. The site encompasses all lands within these boundaries, excluding wholly-improved pasture, arable land, buildings and associated lands.

Ailsa Craig SPA (UK9003091) including marine extension was classified by the Scottish Ministers on the 25th September 2009 qualifies by regularly supporting populations of Northern Gannet and lesser black-backed gull. It regularly supports 65,000 seabirds including nationally important populations of the following species: common guillemot, black-legged kittiwake and herring gull.

8.1.3 Area of Special Scientific Interest (ASSI).

Within Northern Ireland sites that are nationally important for plants, animals or geological or physiographical features are protected by law as Areas of Special Scientific Interest (ASSIs) - and Marine Nature Reserves (MNRs). This system provides the underpinning statutory protection for all sites, including those which are also of international importance. The ASSIs are National designations, special interest by reason of their flora, fauna, or geological or physiographical features. Sites close to the proposed array site with this designation include The Ballycastle Coalfields, Giants Causeway, Rathlin Island, White Park Bay and Torr Head.

8.1.6 National Nature Reserve (NNR)

Nationally important nature conservation sites for biological or earth science interest. Kebble on Rathlin Island is the closest site with this designation to the development.

8.1.7 Area of Outstanding Natural Beauty (AONB).

The Antrim Coast and Glens Area of Outstanding Natural Beauty in 1989 under the Nature Conservation and Amenity Lands (NI) Order. It includes Rathlin Island, the Glens of Antrim and the coastal area between Larne and Ballycastle. It contains some of the most beautiful and varied scenery in Northern Ireland. The area is dominated by the Antrim Plateau rising to over 500m and cut by fast flowing rivers to form a series of picturesque glens running east and north-east towards the sea. It is an area of contrasts with Northern Ireland's only inhabited offshore island, gentle bays and valleys, dramatic headlands, farmland and the wild open expanse of moorland on the plateau. The area has a long settlement history with many important archaeological sites, listed buildings, historic monuments and conservation areas. Rich in folklore, it has a strong cultural heritage and close associations with Scotland. There are fine views eastwards to the Scottish Islands and the Mull of Kintyre which is only 20 km away from Torr Head.

An Antrim Coast and Glens AONB Management Plan and Action Plan has been prepared with five key objectives:

1. Promote greater appreciation and enjoyment of the landscape and wildlife assets of the AONB, and their need for protection and management
2. Undertake survey and research to fill the gaps in the information base needed for wildlife conservation
3. Ensure all designated sites are in good condition by the end of the Vision period in 2028
4. Restore degraded habitats and rebuild the wildlife value of the wider countryside, coast and marine environments
5. Protect the character of the landscape and seascape, restoring key areas of visual prominence where their character has become degraded

The Causeway coast boasts the only World Heritage Site in Northern Ireland. It encompasses 18 miles of spectacular coastal scenery with dramatic cliffs and headlands broken down by the wide sweep of sandy beaches backed by dunes

8.2 Potential Impacts

Indirect effects on designated areas may result from increased sediment transfer, changes in the wave or tidal regime, or impacts on protected species using the site. Some of the potential indirect effects have been highlighted previously in section 6.6 and will be assessed following interrogation of the sediment transport model if required. Impacts on species in transit or foraging might relate to collision, area avoidance and thus loss of foraging area, or disruption to their normal navigational routes and this will be assessed within the respective EIA chapters. Direct or indirect impacts (e.g. on migrating species) are therefore possible and will be assessed as part of the EIA.

9.0 Benthic and Intertidal Ecology

9.1 Current Knowledge

In assessing benthic and intertidal ecology within and adjacent to the proposed array site the following data sources have been used.

- Northern Ireland Marine Renewables and Offshore Wind Strategic Environmental Assessment (SEA);
- Regional Locational Guidance (RLG) for Offshore Renewable Energy Developments in NI Waters;
- Special Protection and Local Action for Species and Habitats (SPLASH) 2004-2008 project;
- Trendall, J.R., Fortune, F. and Bedford, G.S. (2011) Guidance on survey and monitoring in relation to marine renewables deployments in Scotland;
- CEFAS studies (e.g. Walker et al., 2009) Information of impacts of offshore wind farms and cable routes on benthic communities populations;
- Davies et al. (2001). Marine Monitoring Handbook;
- DEFRA (2005). Nature conservation guidance on offshore wind farm development;

AFBI Data:
- Northern Ireland Nearshore Habitat Mapping – Mitchell and Service Report to DOE (2004);
- Northern Ireland State of the Seas –AFBI/DOE 2011;
- Goodwin, C., Edwards H., Breen, J. and Picton, B. (2011) Rathlin Island - A Survey report from the Nationally Important Marine Features Project 2009-2011. Northern Ireland Environment Agency Research and Development Series No. 11/03; and
- UK Biodiversity Action Plan.

9.1.1 Baseline Conditions - Benthic Environment

Benthic ecology studies the flora and fauna living in, on or closely associated with the seabed. Annex I of the European Habitats Directive describes habitats that require designation as Special Areas of Conservation (SACs) for their protection and conservation.

The North Antrim coastline, Rathlin Island and adjacent seabed have a range of habitats consistent with the high energy and exposure from the physical marine environment experienced by most of the area. The area around Rathlin Island and, to a lesser extent, the NE Antrim Maerl beds have been subject to detailed studies, but there are few quantitative surveys over the wider area. Based upon available seabed sediment data, it is expected that the seabed in the area of the proposed development is likely to be comprised of scoured sands and gravels. Multi-beam surveys have recently been carried out as part of the Joint Irish Bathymetric Survey (JIBS) around the coast of Northern Ireland towards the west side of Rathlin Island. These surveys have indicated the likelihood of new Annex I sea bed features including reefs, which may have implications for the proposed array site.

There are currently six marine SACs in Northern Ireland for which benthic ecology is either the primary reason for designation or is a qualifying feature: Rathlin

Island, Maidens, Skerries and Causeways, Red Bay, Murlough (Co Down) and Strangford Lough. Of these six, only Rathlin Island and Red Bay have a potential functional link with the proposed project site as the other sites are considerable distances away.

Maerl beds occur off the coast of Northern Ireland in County Antrim (Figure 9.1) and small areas in the sea loughs. Beds off the coast of Antrim, Northern Ireland, UK, occupy a total area of approximately 7 km^2, (Wilson et al., 2007).

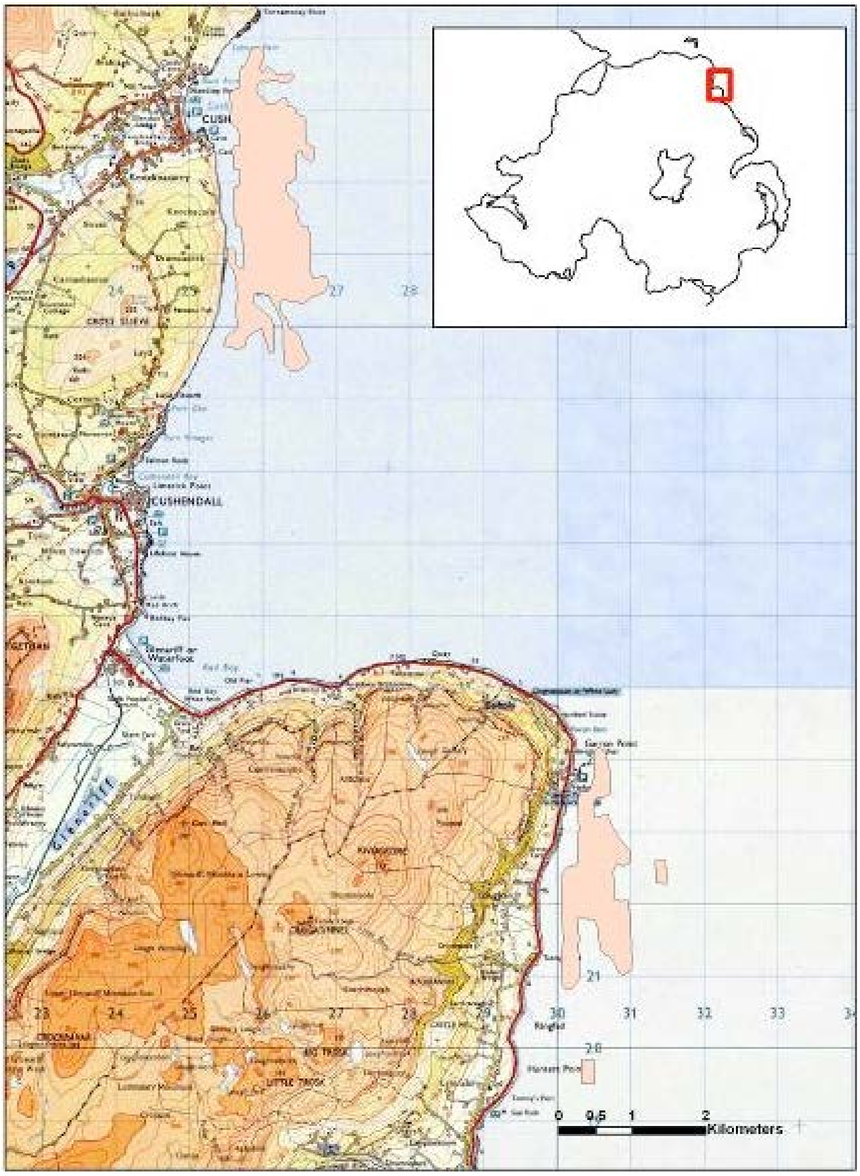


Figure 9.1 Maerl distribution of the Northern Irish Coast

Extensive coastal surveys in Northern Ireland and Great Britain, with both living and dead maerl being surveyed, were carried out under the Special Protection and Local Action for Species and Habitats (SPLASH) 2004-2008 project. The project covered eight modules, seven of which were based on threatened marine species or habitats, the eighth being publicity. Maerl (*Phymatolithon calcareum* and *Lithothamnion coralliodes*) is a corraline algae typically found at less than 20m depth on mud, sand or gravel substrata protected from strong wave action but with moderate to high tidal flow. The Biodiversity Action Plan for Maerl considers the threat to this species to be high as they are long lived and take considerable time to establish colonies. Physical destruction from fishing gear, particularly scallop fishing, poses the most significant threat but the species is also sensitive to other marine engineering activities and sediment generated by these.

One population of Fanshells (*Atrina fragilis*) has been identified of the Antrim coast but the extent of the population is unknown. However, there is evidence that the distribution of *Atrina* was more widespread in the past (Service pers comm.)

The Northern Ireland Marine Renewables and Offshore Wind Strategic Environmental Assessment, SEA also records an area off the north east corner of Antrim as a potential Annex 1 Stony and bedrock reef. The possibility that unrecorded benthic habitats and species may exist in areas outside of those already designated or under consideration for designation may come to light in the course of detailed surveys on potential renewable energy sites.

9.1.2 Baseline Conditions – Intertidal Environment

There is insufficient detailed information available to enable a full ecological assessment of potential landfall sites to take place. Additional survey works will be required and undertaken as part of the EIA.

9.2 Potential Effects

Potential effects can occur to the benthic fauna and flora from marine engineering activities. The potential impacts from the project which could occur are as follows:

9.2.1 Installation

During installation of devices and cables, benthic communities in the vicinity of installation operations could be impacted in the following ways:

9.2.1.1 Substratum changes and loss of species

Substratum changes and loss of species located within the installation area as a result of cable trenching, installation of piles, gravity bases or clump weights, and deployment of anchors and jack-up rigs if used. Indirect effects (increased turbidity and smothering) on the surrounding area could also result from the re-distribution of sediment into the water column. These indirect effects of installation processes may be localised and temporary and are likely to be most significant for installation of export cables, and devices which require structures to be piled into the seabed. Devices which use gravity bases, anchors and clump weights will cause a much smaller spatial impact resulting from disturbance of the seabed and sediment suspension.

9.2.1.2 Smothering

Smothering can occur within the immediate vicinity of the seabed disturbing works, as the coarser fraction of the sediment disturbed is likely to be re-deposited on the seabed. This impact is only expected to be temporary, as material deposited will be re-suspended and distributed by natural hydrodynamic processes, and will only affect those species/habitats that are sensitive to smothering.

9.2.1.3 Increased suspended sediment and turbidity

Increased suspended sediment and turbidity can occur as finer particles travel further from the disturbed area, swept by tidal currents, with potential effects on sessile filter feeders. However, given that the turbines will be placed in high energy environments, it is likely that the small amounts of sediment released into the water column during turbine and cable installation will be rapidly dispersed into the surrounding environment, and will have a negligible impact on background suspended sediment and turbidity levels.

9.2.1.4 Disturbance of contaminated sediments

Disturbance of contaminated sediments is possible during cable and device installation. If seabed disturbing works are undertaken within an area of contaminated seabed, there may be potential effects on nearby species that are sensitive to contamination.

9.2.2 Operation

During device operation the following impacts are possible:

9.2.2.1 Substratum loss

Substratum loss due to the presence of piles, gravity bases, clump weights and anchors on the seabed, or scouring associated with structures piled into the seabed. Depending on design devices are expected to each occupy a seabed area of between $12m^2$ (piles) and up to $40m^2$ (gravity bases) per turbine.

9.2.2.2 Decrease in water flow

Decrease in water flow resulting from extraction of tidal energy, may potentially impact on habitats and species which are sensitive to changes to tidal flows and wave exposure. Marine life in tidal rapids relies on the strong currents to carry food in, and move waste materials and fine sediments away. Therefore, interruptions of tidal flows may have implications for fauna and flora. Benthic habitats are also potentially affected by changes in sediment patterns as a result of reduction in tidal flows. Whether significant changes in community structure would occur and whether they would be considered deleterious would depend on the degree of change and the nature of the receiving environment. Based on limited existing projects and modelling studies, it is estimated that the extent of measurable impact on tidal energy may extend up 0.5km from the tidal device as defined in the NI SEA.

9.2.2.3 Changes in suspended sediment levels and turbidity

Changes in suspended sediment levels and turbidity may be caused by changes to sedimentation patterns resulting from extraction of tidal energy. Depending on the specific environmental parameters at a given location this may result in increases or decreases of both sediment suspension and deposition. High confidence estimates, based on expert knowledge can be given for the extent of impacts on sediment processes of up to 50m from devices as defined in the NI SEA.

9.2.2.4 Leaching of toxic compounds

There is also the potential for leaching of toxic compounds from sacrificial anodes, antifouling paints or hydraulic fluids (if present) from a device. Tidal devices are expected to use antifouling coatings, and whilst organotins are now banned, the use of copper is still permitted.

9.2.2.5 Potential for leakage of hydraulic fluids

The potential for leakage of hydraulic fluids through accidental storm, mechanical failure or collision damage could potentially present a significant impact, but it is considered that there is a very low likelihood of such a leakage occurring. Potentially more significant are the possible impacts that could result from leakage of cargoes or fuel carried by a vessel involved in a collision with a tidal turbine.

9.2.2.6 Colonisation of structures

There is also potential for colonisation of structures causing increased biodiversity and leading to increased food availability for fisheries. Species colonising underwater structures may lead to undesirable changes in community structure

9.2.3 Decommissioning

Potential effects are predicted to be similar to installation except that since much of the foundation may be left in situ. Dependent upon the depth of excavation required, the amount of sediment release is likely to be lower than that released during construction.

9.3 Scope and Methodology - Benthic and Intertidal Ecology

The baseline status for flora and fauna in the area of the proposed array / cable routes and surrounding areas will be fully investigated and mapped as part of the design and the EIA process. This will involve both desk based reviews and surveys.

9.3.1 Literature Review

AFBI will undertake a comprehensive desktop review of existing information on the benthic ecology of the area of the Fair Head Tidal Project site and cable route. We have thus far identified a number of information sources (Table 9.1).

Source	Description
Northern Ireland Nearshore Habitat Mapping	QUB/DARD report to EHS detailing broadscale sub-tidal habitat distribution
Conservation Agency (NIEA/ DoE Marine Division) reports and data	Data and reports held on distribution of marine species and habitats in the area, including SAC designation and condition monitoring and Priority Marine Feature mapping studies
ICES	Larval and Juvenile surveys
Marlin and NBN Gateway	Distribution maps and sensitivity information on species and habitats
JNCC Marine Nature Conservation Reviews	General description of the marine communities throughout an area
Local marine biology stations	PhD /MPhil studies carried out in this area & long term monitoring data on benthic sampling station
Marine European Seabed Habitats (MESH)	General description of the benthic communities throughout an area (EUNIS habitat classification system)
Published scientific articles	Specific scientific studies on benthic/epibenthic species and habitat conducted in this area
AFBI Science	Data on long term benthic & epibenthic sampling stations; contaminated sediment studies; relevant research projects (e.g. studies on impacts of trawling can provide background data on benthos); young fish studies (data from

Source	Description
	epibenthic trawls)
National Marine Monitoring Programme	Long term data from specific benthic/epibenthic sampling stations; contaminated sediment surveys
Strategic Environmental Assessments	General information on designated sites in the area
Ulster Museum	CEDAR database and associated reports and publications.
Local Council	Biodiversity and survey data and reports held by the council
Cowrie	Information of impacts of offshore wind farms and cable routes on benthic communities populations
CEFAS studies (e.g. Walker et al., 2009)	Information of impacts of offshore wind farms and cable routes on benthic communities populations

Table 9.1 Sources of information for the literature review on benthic & fisheries ecology in the waters around Fair Head.

9.3.2 Baseline Surveys

Baseline surveys are required to characterise the benthic (including fish and shellfish) ecology and surface sediments along the proposed Fair Head Tidal Energy Project site and cable route.

Benthic surveys can provide baseline information for direct comparison with post construction surveys.

All surveys will be agreed with DoE MD and NIEA prior to commencement and will be conducted using current best practice guidance for use in assessing impact upon benthic ecology:

- Trendall, J.R., Fortune, F. and Bedford, G.S. (2011) Guidance on survey and monitoring in relation to marine renewables deployments in Scotland;
- Davies et al. (2001). Marine Monitoring Handbook; and
- DEFRA (2005). Nature conservation guidance on offshore wind farm development.

9.3.3 Survey Planning

Characterisation of benthic habitats is best achieved through a combination of acoustic mapping of seabed habitat features followed by targeted (stratified) single sample station ground truthing (Ware et al., 2011). The first stage of this is detailed analysis of the geophysical data to create potential habitat maps.

Undertaking this analysis will allow the production of a robust survey program as habitat interpretation of geophysical physical data is a requirement of the current best practice advice for benthic characterisation (e.g. Ware *et al.,* 2011; Trendall *et al.,* 2011 etc).

The available data will be reviewed, including geophysical datasets and any existing benthic habitat and environmental data. Assuming the data were suitable, the area would be clustered on the basis of key environmental variables, such as depth (particularly with respect to upper and lower circalittoral) and substratum. The indicative habitat map and information from the benthic literature review will then be used to determine the most appropriate type of sampling methodology and to position the sampling stations for all benthic surveys (DDV, grab and epibenthic). A process using optimal allocation has been developed (Clements et al. 2010) which allows the selection of sample stations to provide a level of confidence to the production of habitat maps. Should any information from the environmental data indicate species or habitats protected under the UK Biodiversity Action Plan (BAP) or included in the Northern Irish draft list of Priority Marine Features, any survey plan and methodology would incorporate these features and prevent disturbance to them.

Information from the review would be used to select the sampling locations. The aim is to ensure that representative samples of the likely range of habitats are sufficient to describe the whole area of interest. The sampling regime will represent a random stratified approach with a minimum of three stations within each habitat type to accurately and robustly ground truth the habitat maps. Where the existing data is of sufficient quality it may be possible to determine the appropriate number of replicates to allow trends to be observed.

Following the geophysical interpretation, literature review and sampling station planning, a Survey Monitoring Plan (SMP) will be produced. This will include specifications of the surveys including methods, timings and location of the sampling stations. Prior to surveys commencing, the SMP would be sent to DoE MD for comments and approval.

Prior to commencement of the surveys, Special Dispensation for the use of undersized mesh in the epibenthic beam trawl survey would be sought from DARD.

9.3.4 Survey Methodology

A suggested survey methodology is proposed in Table 9.2.

Survey methodology	Purpose
Underwater camera (DDV)	To obtain information on epibenthic communities. To identify sensitive habitats prior to grab or epibenthic beam trawl deployment
Quantitative grabs	To obtain information on infauna and sediment characteristics
Quantitative epibenthic beam trawl	To obtain information on mobile epibenthos (including fish and shell fish)
Intertidal surveys	To map the biotopes & sensitive habitats at each cable land fall.

Table 9.2: Proposed survey methodology

It is proposed to carry out a drop down video (DDV) at each sampling station prior to dropping the grab. Where the seabed is comprised of rock, or where sensitive habitats (such Annex 1 reef or Priority Marine Feature [PMF]) characterisation would be based purely on camera observations. In areas where substrates mean grab samples cannot be obtained, an epibenthic beam trawl may be deployed, however if the habitat is considered sensitive camera images may be used to characterise the epibenthos.

9.3.5 Video Survey Methodology

The most suitable video system would be selected for use during the survey given the environmental conditions. Rugged terrain in strong tidal and exposed locations may demand the use of small, robust systems.

A comprehensive video log would be kept, noting position, depth, substrate, conspicuous biota and the presence of any sensitive habitat which should be avoided. Video sampling will deployed using a USBL system to allow for the correct position of the sample.

9.3.6 Infaunal Community – Grab Sampling Survey

The infaunal community will be quantitatively assessed by undertaking a grab sampling survey. The benthic grab sampling survey and laboratory analysis will follow the procedural guideline No. 3-9 of the JNCC Marine Monitoring Handbook.

Grabs can only operate where there are soft sediments on the seabed. The grab samples will be taken using the most appropriate equipment based on sediment types identified from the geophysical survey data, this is expected to be a Day grabbut the use of Hamon Grab will be considered for gravels. At each sampling station the time and location (coordinates) of where the grab is deployed will be recorded as well as depth, water temperature, salinity, turbidity and prevailing weather conditions.

After the grab is recovered a visual assessment of sediment will be made and a sub-sample taken for particle size analysis (PSA) and Total Organic Carbon (TOC) analysis. The remainder of the sediment will then be sieved through a 1mm mesh and what is retained on the sieve will be preserved in labelled pots containing buffered 4% seawater formaldehyde.

9.3.7 Laboratory Analysis

Taxonomic identification of the infauna found in the samples will be undertaken by specialist laboratory analysts, while the PSA and TOC analysis on the sediment samples will be undertaken by a suitable qualified laboratory using NMBAQC guidelines.

All fauna in the samples will be identified to species level. All extracted material will be stored in 70% industrial methylated spirits.

9.3.8 Epibenthic Beam Trawl Survey

An epibenthic beam trawl would be required to collect information on epibenthic species including fish and shellfish. This would be carried out using a 2m beam trawl and following the guidance laid out in Procedural Guidance 4-3 of the JNCC Marine Monitoring Handbook.

The epibenthic sampling stations would be spatially coincident with some of the benthic grab sampling stations, in order to provide information on the epibenthos present and therefore assist with biotope identification. Epibenthic trawls would not be deployed in areas where sensitive habitats have been identified through the drop-down video survey.

After each tow the catch will be processed on board. The contents of the cod-end shall be examined and all species of flora and fauna identified to species and counted prior to being released to the sea. In addition the total length of all fish and carapace length (width for crabs) of crustaceans of commercial importance shall be recorded. Species will be measured using the methods set out in EC Regulation 850/981.

9.3.9 Intertidal surveys

The export cable route from the site will come ashore on the North Antrim Coast. Site-specific intertidal surveys will be required at each cable route landing point as well as the exit point in order to assess the potential for intertidal Annex I habitats and PMFs in the vicinity of the cable route as well as characterise and map the intertidal habitats.

Intertidal habitats will be surveyed at each potential landfall using intertidal biotope mapping techniques. This will include both walk-over surveys as well as taking sediment cores to identify infaunal communities on sediment shores. The survey would be performed low spring tides. On each occasion two surveyors would visit the shore 3 hours before low water and they would leave the shore no later than 3 hours after low water. The survey date would be chosen to maximise daylight over the low water period.

Within this intertidal cable buffer zone rocky biotopes will be identified and mapped according to Procedural Guideline No. 3-1 of the JNCC Marine Monitoring Handbook. Sediment shores will be surveyed using methods compliment with Procedural Guideline No. 3-6 of the JNCC Marine Monitoring Handbook. At each shore 3 transects will be established within the cable buffer zone and sampling station placed corresponding to lower, mid and upper shore along each transect. Faunal samples would be sent to a suitably qualified laboratory where they would be identified to species level. Sediment samples would be analysis in suitably qualified laboratory for PSA and TOC.

9.3.10 Survey Data Analysis

Habitat Mapping

All data collected from the DDV, grab, epibenthic trawl and intertidal surveys (including species abundance and physical parameters such as PSA data) will be collated. These will be used in conjunction with the geophysical data and survey log information to produce interpretative habitat maps which will characterise the survey area. This will effectively ground truth the continuous geophysical data with the point sample data using image processing and statistical analysis.

10.0 Fish and Shellfish

10.1 Introduction

This chapter focuses largely on shellfish as there are no adjacent commercial fin-fisheries in the area. Recreational sea-angling is important in the area.

Shellfish is a generic term used to cover crustacean and mollusc species. Of principal commercial importance to this sector are the crustaceans such as Lobster and Crabs, Bivalve Molluscs such as Scallops, Queen Scallops and Mussels, and Gastropods such as Whelks.

For any assessment of the effects of tidal devices on fish and shell fish, it is necessary to consider all life history stages that often differ quite considerably between species. Another consideration is the mobility of the species at each of their life history stages and their ability to avoid potentially harmful devices. An assessment is required to determine the extent of the interaction between the proposed development and the resources found at the site.

Fish species of interest are elasmobranches, including sharks, skates and rays which may be sensitive to electromagnetic frequencies created by cables. Basking sharks which are being surveyed in conjunction with the mammal surveys have been included in Chapter 12 – Marine Mammals, Basking Sharks and Turtles.

Some species, such as Atlantic salmon, trout and eels spend part of their lifecycle in freshwater and part at sea. Migration between these two water bodies, they return to the river in which they were born to spawn the next generation, is important for the survival of the species. There are several rivers along the North Antrim coastline where the Atlantic Salmon and Sea Trout spawn, these include the rivers Bush, Glenshesk, Glendun, Glenarriff and Glenacun. The migration of salmonids to and from the rivers and sea give rise to 'salmon runs' along the coastline some of which are likely to pass through the proposed array site.

Salmon and eel are now species of conservation interest with EU developed stock management and conservation plans in place, each of which has to produce or attain conservation targets aimed at improving the levels of both fish species which migrate to the sea. The salmon and eels are high value commercial fisheries of economic importance within NI and the EU. More detailed info is available from ICES and NASCO websites.

There are no aquaculture developments in or near to the site and future development is unlikely due to absence of required physical conditions.

10.2 Current Knowledge

Desk based data has been gathered from the following sources:

- NI SEA;
- Information on nursery and spawning grounds from CEFAS (Coull et al. 1998)

- Fisheries Sensitivity maps in British Waters, (Fisheries research Services, CEFAS, UK Offshore Operations Association limited, National federation of Fishermens Organisations and Scottish Fishermens Federation.
- Northern Irelands' Priority Species and Species of Concern list (National Museums Northern Ireland 2006-7)
- DARD/MFA fisheries statistics (MFA 2009)
- Position statement on sharks, skates and rays in Northern Ireland waters (Agri- Food and Biosciences Institute 2009)
- The Marine Life Information Network for Britain and Ireland (MarLIN).
- Ulster Wildlife Trust 2006, The Ulster Wildlife Trust Basking Shark Project: Environment and Heritage Service Research and Development Series, No/ 06/16
- A Sustainable Development Strategy for Northern Ireland Inshore Fisheries. AFBI 2013

10.3 Potential Effects

10.3.1 Installation of Turbines and Subsea Cables

10.3.1.1 Disturbance

Disturbance of mobile species can occur during installation of turbines and cables, as a result of the presence of the installation vessels and equipment (and associated noise) within the vicinity of operations. In addition, the noise generated by piling is likely to have a greater disturbance impact than for developments where piling is not required. Whilst piling noise would only be produced over a temporary period, for the duration of construction activities, the impacts may continue for longer, as fish may not immediately return to an area, particularly if they have been excluded for lengthy periods. The timing of installation works is also a key factor, as the disturbance effect is likely to be greater during mating aggregations, as it may affect mating activity.

10.3.1.2 Smothering

Smothering of fish spawning habitat or shellfish habitat could occur within the immediate vicinity of the seabed disturbing works, as the coarser fraction of the sediment disturbed is likely to be re-deposited on the seabed within about 50m of the works. As the area occupied by each device, would not exceed 1% of the sea bed within the area of the array the potential for smothering is relatively low. Given the strong tidal currents in the area any fine particles created or sediments displaced will be rapidly dispersed.

Based on the sensitivity data available from The Marine Life Information Network for Britain and Ireland (MarLIN). most fish species within the study area are not sensitive to, and therefore not affected by the impacts of smothering. The exceptions however include certain demersal species: lesser spotted dogfish, thornback ray, common skate, lemon sole and plaice which all have a low sensitivity to smothering. The spawning areas of finfish species herring and sandeels are highly sensitive to smothering impacts.

Shellfish inhabiting the seabed are generally more sensitive to the impacts of smothering. *Nephrops* (Norway lobster), king and queen scallop, cockles and periwinkles are all highly sensitive. Whilst European lobsters, edible crab, velvet crab, whelk and mussel have medium to low sensitivity.

10.3.1.3 Increased Suspended Sediment and Turbidity

This can occur as finer particles travel further from the disturbed area, swept by tidal currents, with potential effects on filter feeders. King and queen scallop, cockle, mussel, herring and sprat all have a medium sensitivity to increased suspended sediment. All other fish and shellfish species, for which the sensitivity is known, have low or no known sensitivity to this impact.

10.3.1.4 Disturbance of Contaminated Sediments

This effect can occur during cable and device installation, which may cause potentially detrimental impacts on species that are sensitive to contamination. Areas of potential contamination risk and the associated implications for water quality are discussed in chapter 7.

10.3.1.5 Marine Noise

Noise from marine developments has the potential to impact fish in the immediate vicinity of operations. The expected sources and impacts of noise on the marine environment are discussed further in chapter 12 marine mammals and chapter 20, noise.

Key sources of noise during installation are shipping machinery, dredging and pile driving. Pile driving is anticipated to have the greatest potential effects on marine wildlife, as it generates very high sound pressure levels that are relatively broad-band (20 Hz - > 20 kHz).

10.3.2 Operation

10.3.2.1 Collision Risk

Collision risk is considered to be a key potential effect during turbine operation. The group of species at risk will vary depending on the type of device and its location within the water column. Demersal fish, for example spend their time near the sea bed and are unlikely to be affected by turbine rotors. It is possible that they may benefit from the habitat structure provided by the foundations. Some demersal species for example Plaice or cod may interact with turbines in mid water when they make excursions up the water column or when using tidal stream transport during migration.

Pelagic species of fish will be at some risk of interaction with all types of device. Their diurnal vertical migration behaviour forces them to occupy all depths in the water column at some time during the day.

In addition there are a number of other parameters that can be expected to affect the degree of collision risk:

10.3.2.2 Size:

Very small fish and larval fish with very low inertia experiencing the proportionate effects of the viscous flow regime are more likely to follow the flow streamlines around moving parts and thus avoid collision. The collision risk increases with increasing fish size, and the greatest collision risk, as far as fish size is concerned, is therefore expected to apply to basking shark.

10.3.2.3 Schooling Behaviour:

Schooling species may be at greater risk than those with a solitary habit. A school could be regarded as a large "super organism" rather than behaving as individual. Schools of fish often move together in polarised formations and their predator escape behaviour is coordinated. Responses may lead to some individuals evading contact with turbine blades; whilst others could be directed into the path of a blade.

10.3.2.4 Life Stage:

Juveniles likely to be more at risk than adults because of reduced sensory and mobility abilities and/or experience.

10.3.2.5 Season:

Species at most risk will also vary with season, due to seasonal change in geographic distribution, migrations and spawning periods.

Fixed submerged structures (such as vertical or horizontal support piles, ducts & nacelles) are likely to attract marine life in the manner of artificial reefs or fish aggregating devices. Mooring equipment such as anchor blocks and plinths are likely to function like other natural or artificial seabed structures and hence pose few novel risks for vertebrates in the water column.

Collision risk is expected to be influenced by the nature of the environment where the turbines are located:

10.3.2.6 Open Water:

Deployment of devices in the open sea will present the least risk unless the spacing between devices increases the risk of encounter (see above). However, water depth at the point of deployment will be critical and turbines need to be raised far enough off the bottom to reduce interaction with benthic fish.

10.3.2.7 High Flow Environments:

High flows can combine with swimming speeds to produce high approach velocities and consequently reduced avoidance or evasion response times. In high flow environments, fish may hold station in front of a device until they reach exhaustion and then passively be swept downstream towards it. This observation is based on research undertaken into fishing methods, and why fish become swept into trawling nets

10.3.2.8 Turbidity:

Collision risk can be expected to be greater for turbines deployed in regions of moderate to high turbidity, or if the turbines themselves increase turbidity. This is because of the turbines' reduced visibility, and also because turbid waters are actively selected by many fish species, possibly as a refuge from predators.

Ecological impacts resulting from fish interactions with devices can be expected to range from no impacts to the potential removal or injury of individuals, and, if rates are sufficiently high, declines in populations. If avoidance responses occur then habitat exclusion is possible while if structures provide foraging opportunities then this could cause positive impacts.

Consideration will be given within the EIA to the various device types which might fall within the design envelope. In particular any differences in collision risks associated with either open or closed rotors will be assessed.

10.3.2.9 Substratum Loss:

The presence of gravity bases, clump weights and anchors on the seabed, or scouring associated with structures piled into the seabed, will cause loss of seabed habitat during device operation.

It is estimated that for a typical array of 30 – 100 tidal devices each occupying a seabed area of 12m^2 an approximate estimate of the area of seabed lost for each array would therefore be 0.36km^2 as defined in the NI SEA. This impact is only directly relevant for shellfish and benthic spawners such as sandeels and herring, although there could be a knock-on effect on other fish species by affecting their benthic food resources.

10.3.2.10 Decrease in Water Flow:

A decrease in water flow resulting from extraction of tidal energy, will potentially impact on habitats and species which are sensitive to changes to tidal flows and wave exposure. Based on limited existing projects and modelling studies, it is estimated that the extent of impact on tidal energy can extend up 0.5km from the tidal device as defined in the NI SEA. This impact mainly applies to shellfish which range from low – medium sensitivity to changes to tidal flows. However, as herring spawn on gravel beds created by high water flow, herring spawning areas are also likely to be sensitive to this impact.

10.3.2.11 Changes in Suspended Sediment Levels and Turbidity:

These changes may be caused by changes to sedimentation patterns resulting from extraction of tide and wave energy. Depending on the specific environmental parameters at a given location this may result in increases or decreases of both sediment suspension and deposition. High confidence estimates, based on expert knowledge can be given for the extent of impacts on sediment processes of up to 50m from devices. King scallop, queen scallop, cockle, mussel, herring and sprat have a medium sensitivity to this impact. All other fish and shellfish species commonly found in the study area, for which the sensitivity is known, have low or no sensitivity to this.

10.3.2.12 Contamination:

Leaching of toxic compounds from sacrificial anodes, antifouling paints or hydraulic fluids (if present) from the device is a potential effect during device operation. A number of tidal devices are expected to use antifouling coatings, and whilst organotins are now banned, the use of copper is still permitted. For most of the finfish species likely to be present in the study area, sensitivity to this impact is not known.

Shellfish species present in the study area have a generally low to very low sensitivity to heavy metal and synthetic chemical contamination that could result from use of copper based anti-foulants or from sacrificial anodes. The quantities and toxicities associated with sacrificial anodes and antifouling coatings are generally expected to be extremely small. The potential for leakage of hydraulic fluids through accidental storm or collision damage could potentially present a significant impact if it occurred. Potentially more significant still are the possible impacts that could result from leakage of cargoes or fuel carried by a vessel involved in a collision with a tidal turbine.

10.3.2.13 EMF:

Electricity cables produce small electric and magnetic fields, which have the potential to affect migration and prey detection in certain electro-sensitive fish species such as elasmobranchs (sharks and rays). Torr Head is known to be a major migration route for Northern Ireland salmon populations. Atlantic salmon, eels and Sea Trout are believed to be sensitive to magnetic fields also. However, the level of impact associated with inter-turbine arrays will be more concentrated than those for export cables. There is no evidence to indicate that existing cables have caused any significant effect on migration patterns of these species. This potential effect is assessed further in chapter 21 Electromagnetic Fields.

10.3.2.14 Noise:

Marine fish can produce and hear marine noise which, whilst not fully understood, is thought to be associated with alarm calls and social behaviour, and studies have found that general noise such as is generated by shipping activity can cause an avoidance or attraction reaction in fish. Noise from tidal energy projects therefore has the potential effect on fish in the immediate vicinity of devices. This is discussed further in chapter 12 Marine Mammals and chapter 20 Noise.

10.3.2.15 Fishing Exclusion Areas:

There is also a potential positive impact on fish resources should the tidal array be excluded from fishing activities, as this could create spawning grounds and nursery areas that will be able to exist undisturbed by commercial fishing activity. Furthermore, with sensitive design, tidal installations could potentially form artificial reefs.

10.3.2.16 Barrier to Movement:

There is the potential that arrays of devices may form a barrier to the usual migration and transit patterns of marine finfish, either because of collision risk, aversive reactions to operation noise or perceptions of devices and associated infrastructure. This is particularly relevant in constrained areas (such as mouths of sea lochs).

10.3.3 Decommissioning

Potential effects are predicted to be similar to installation except that since much of the foundation will be left *in situ* the amount of sediment release is likely to be significantly lower than that released during construction. This is clearly dependent on the depth of excavation required.

10.4 Scope and Methodology – Fish and Shellfish

The assessment will be structured in the following stages:

10.4.1 Desk Based Assessment

There is a considerable quantity of information on fish and shellfish for the N Ireland coastal zone available in published documents, scientific reports and from the commercial fisheries AFBI (2013) Inshore Fisheries Review. The first stage will be to assess this information to determine the presence, distribution and seasonality of the fish and shellfish resources. Information to be gathered will include:

- Major species of fish and shellfish in the area that are of significant importance in commercial and recreational fisheries;
- Species of fish in the area that are of conservation importance;
- Elasmobranch fish (fish able to detect electrical fields like sharks, rays and skates) in the area and along the cable route; and
- Species that have a restricted geographical distribution and are locally abundant in the area.

When the important fish and shellfish species present at or near the proposed site have been identified, aspects of their ecology that may be affected by the construction will be determined. For fish and shellfish, the following aspects of their ecology will be assessed where relevant and whenever information is available:

- Spawning grounds;
- Nursery grounds;
- Feeding grounds;
- Migration routes; and
- Overwintering areas for crustaceans (e.g. lobster and crab)

10.4.2 Consultation

At the Torr Head and Fair Head tidal turbine project meeting with Fishing Stakeholders and DOENI Marine Division in Portrush in November 2012, it was agreed that a Liaison Group consisting of DARD Fisheries, DOE Marine Licensing Team, DCAL Fisheries and key fishing industry and fishing community representatives was required. The aim of this group will be to liaise with each other on a regular basis, facilitate communications and direct consultation and assist in the environmental assessment for the project proposals. It was agreed that Bob McMullan, of the North Coast Lobster Fishermen's Association, should be the Fishing Liaison officer and would be the point of contact for the fishing industry and DOE Marine & project developers in relation to the Fishing Liaison Group.

10.4.2.1 Fisheries Stakeholder Meetings

Advertised and targeted stakeholder meetings will be open to all fisheries interests in the regional area. Such meetings will have the benefit of disseminating relevant project information, identifying stakeholders and identifying concerns regarding the development. Contact details for all attendees will be taken and stored on a fishermen's register, specific to the project. It is recommended that fisheries stakeholder meetings are held at suitable milestones in the project's development.

10.4.3 Field Surveys

The results from the desk study and consultation will be submitted to DOE Marine Division and the quality of the site specific information will be assessed jointly with the authorities. The requirement for field surveys will depend on whether the data set meets the requirements of the authorities and contains a sufficient amount and quality of information to determine possible impact from the proposed tidal farm, if so then no field surveys will be needed.

If, on the other hand, the data show that the information is insufficient to meet the requirements of the authorities, e.g. due to lack of information or due to an issue of local concern, specific field surveys will be initiated to cover information gaps.

Methodologies for possibly field studies in relation to suitable gear, sampling method and data analysis will be agreed upon in consultation DOE Marine Division.

11.0 Birds

11.1 Introduction

This chapter, in association with Appendix 2 - Survey Programme for Seabirds and Marine Mammals at Fair Head Tidal Energy Site presents the approach to impact assessment in relation to birds to support the development of an application for consent for the FHTEP site.

The EIA will include a baseline ornithological characterisation of the areas potentially affected by the proposed tidal farm. This will include describing the range of species occurring, together with their distribution, abundance and behaviour and how these change seasonally. The ornithological importance of the area will be established in the context species' national and regional populations sizes and their conservation status. The potential effects that the proposed tidal farm could have on birds will be described and assessed following the methods set out in guidance (for example IEEM 2010). The assessment will be broken down into two areas, birds potentially affected by marine activities and birds potentially affected by associated onshore works.

11.2 Current Knowledge

Birds are well studied and consequently there is considerable information on which species occur in the areas predicted to be affected (Mitchell *et al.* 2004, Kober *et al*. 2010), the ecology and behaviour of these species (e.g. Wernham *et al*. 2003, Thaxter *et al*. 2012), and how they may be affected (e.g. Furness *et al*. 2012, McCluskie *et al*. 2012).

In the case of seabirds, two sources of information are particularly useful for giving an overview of the expected value of the area to each seabird species. These are the national Seabird Monitoring Program database on breeding seabird colonies maintained by the Joint Nature Conservation Committee (JNCC) (Website, and summarised in Mitchell et al. 2004) and the published maps of at sea seabird distribution and abundance based on a synthesis of ESAS and aerial survey data obtained over many years from around the UK (e.g. Kober et al. 2010). In addition there are numerous tagging studies that reveal the extent of foraging ranges made by seabirds from colonies (e.g. Thaxter et al. 2012).

Based on the results in Kober et al. 2010 and Mitchell et al. 2004, the expected status of seabirds in the Fair Head area is summarised in Table 11.1. This shows that around 21 species of seabird are expected to occur. Ten of these species are expected to occur at very low densities and the area is likely to have very low importance for these species. It also shows that nearby (approximately 10 km away) Rathlin Island is the closest breeding colony for many species.

In the breeding season, four species are expected to occur at moderate or high relative densities, namely kittiwake (Rissa tridactyla), common guillemot (Uria aalge), razorbill (Alca torda) and black guillemot (Cepphus grylle). These are all species that breed in relatively large numbers on Rathlin Island. Rathlin Island also holds small numbers of breeding puffin (Fratercula arctica), shag (Phalacrocorax aristotelis), fulmar (Fulmarus glacialis) and herring gull (Larus argentatus), lesser black-backed gull (L. fuscus) and great black-backed gull (L. marinus) and is the most likely origin for the low numbers of these species expected to be present in the spring and summer months.

In the autumn and winter months the range and numbers of seabirds present is expected to be smaller, reflecting the seasonal movement undertaken by many seabird species. No species is expected to be present in high relative densities at this time of year. Five species are expected to occur in moderate relative densities in the autumn and winter, namely common guillemot, razorbill and black guillemot, herring gull and great black-backed gull. With the exception of black guillemot, the individuals of these species present in autumn and winter are likely to originate outside the local breeding area, in particular breeding sites in Scotland and overseas such as in Iceland.

Species	Breeding season density	Autumn and winter density	Nearest important breeding colony and distance (km)
Northern fulmar (*Fulmarus glacialis*)	Very low	Very low	Rathlin Island, 10 km
Manx shearwater (*Puffinus puffinus*)	Low	Absent	Copeland Islands, 73 km
Sooty shearwater (*Puffinus griseus*)	Very low	Absent	Breeds in South Atlantic
European storm petrel (*Hydrobates pelagicus*)	Very low	Absent	Sanda, 33 km
Northern gannet (*Morus bassanus*)	Low	Low	Ailsa Craig, 62 km
Cormorant (Phalacrocorax carbo)	Very low	Very low	Sheep Island, 15 km
European shag (Phalacrocorax aristotelis)	Low	Very low	Rathlin Island, 10 km
Arctic skua (*Stercorarius parasiticus)*	Very low	Absent	Treshnish Islands, 140 km
Great skua (Stercorarius skua)	Low	Very low	Mingulay, 200 km
Black-footed kittiwake (*Rissa tridactyla*)	Moderate	Low	Rathlin Island, 10 km
Great black-backed gull (*Larus marinus*)	Low	Moderate	Rathlin Island, 10 km, (small numbers)
Herring gull (Larus argentatus)	Low	Moderate	Rathlin Island, 10 km, (small numbers)
Lesser black-backed gull (*Larus fuscus*)	Very low	Very low	Rathlin Island, 10 km, (small numbers)
Sandwich tern (Sterna sandvicensis)	Very low	Absent	Blue Circle Island, Larne Lough, 56 km
Arctic tern (Sterna paradisaea)	Very low	Absent	Copeland Islands, 73 km
Common tern (*Sterna hirundo*)	Very low	Absent	Blue Circle Island, Larne Lough, 56 km
Common guillemot (*Uria aalge*)	High	Moderate	Rathlin Island, 10 km
Razorbill (*Alca torda*)	High	Moderate	Rathlin Island, 10 km
Puffin (Fratercula arctica)	Low	Low	Rathlin Island, 10 km, (small numbers)
Black guillemot (*Cepphus grylle*)	Moderate	Moderate	Rathlin Island, 10 km
Little auk (*Alle alle*)	Absent	Very low	Breeds in Arctic latitudes
All seaduck species	Absent	Absent	Habitat apparently unsuitable

Table 11.1: The Expected Status of Seabirds in the Fair Head Survey Area Based on Existing Information.

The density category is derived from Kober *et al.* (2010) and is relative to the range of densities reported for that species across UK waters. The breeding colony information is based on results of the Seabird 2000 census (Mitchell *et al*. 2004)

11.3 Designated Areas and Protected Species

The North Antrim coast has significant ornithological interest, and there are a number of sites designated for birds and their habitats at both the national level, Areas of Significant Scientific Interest (ASSIs) or international level (Special Protection Areas (SPAs) and Ramsar sites) (Table 8.1). The importance to birds of these designated areas is relatively well documented and will inform the onshore element of the proposal.

Rathlin Island SPA has particular relevance to the proposal due to its relatively close proximity (5km at its closest). This SPA is designated for breeding seabirds and peregrine and includes the surrounding marine area between about 800m and 1.3 km from the coast

Work is also currently underway by the JNCC (http://jncc.defra.gov.uk/page-1414) and the four country nature conservation agencies to identify further SPAs with marine components that will comprise a suite of entirely marine SPAs. Sites that are currently being considered for designation include:

- Offshore aggregations of seabirds; and
- Important feeding locations for particular species.

11.4 Potential Impacts – Seabirds

11.4.1 Installation Phase

11.4.1.1 Disturbance

Birds may be disturbed directly or passively by installation activities with the result that they are displaced from the vicinity of construction activities and vessels. This effectively amounts to temporary habitat loss as these birds are deprived from an area of habitat they would have otherwise used. Direct disturbance is caused when birds respond directly to an event such as an approaching vessel or loud noise. Such disturbance events are likely to be short term in duration. Passive disturbance is caused when birds show a general avoidance response to the presence of infrastructure, installation equipment or vessels, and is likely to be of medium term duration, lasting as long as the stimulus remains present.

Seabird species are known to vary in their susceptibility to disturbance (Garthe and Hüppop 2004, Schwemmer *et al*. 2010). Some species may show a negative response to human activity at distances as far as approximately 1km away, but most, including those identified as most likely to use the area affected, are likely to be more tolerant. Indeed, some species (such as some gull species) may even be attracted to the vicinity of marine human activity.

11.4.1.2 Marine Noise:

There is no evidence that diving birds, those species that spend part of their lives underwater, have a high vulnerability to loud marine noise, for example in the ways that certain fish and cetacean species are known to have. Birds do of course have excellent hearing and will hear construction noise when they are above or below water and in certain circumstances may show a disturbance response to noise stimuli, as discussed under disturbance above.

11.4.1.3 Increased Water Turbidity:

Vision is the primary sense that seabirds use to find and locate mobile prey, such as fish. Therefore, reduced underwater visibility caused by increased water turbidity can potentially impair birds' foraging behaviour.

Turbine and cable installation activities on the sea bed are likely to cause some disturbance to marine sediments, which in turn could cause reductions in visibility. However, given that the tidal turbines will be in a high energy environment, it is likely that the small amounts of sediment disturbed into the water column by installation works would be rapidly dispersed into the surrounding environment, and therefore any change to visibility will be localised and of short-term duration.

11.4.1.4 Seabed Habitat Change:

The footprint of turbine bases and rock armour laid to protect cabling on the sea bed will result in a minor loss of sea bed habitat. The likely magnitude of this loss is so small that it is very unlikely to have more than a negligible effect on seabirds. Furthermore, the surfaces of turbine foundations and rock armour will effectively be artificial reef habitat which in time will be colonised by a wide range of marine flora and fauna. Again, because of the small areas involved, the impacts of this on seabirds are expected to be negligible. Nevertheless the impacts of such artificial reef would be expected to generally positive for birds and broadly compensate for the any negative impacts caused by the original habitat loss.

11.4.1.5 Pollution and contamination:

Activities in the installation phase could lead to contamination of the marine environment by litter, toxins from antifouling paints, oil and other fluids. All these could have lethal or sub-lethal effects on seabirds. Oil pollution could result from leaks from turbine nacelles and by ships colliding with infrastructure. However, provided the various marine codes and guidelines are followed none of these are likely to have more than negligible impacts in seabird populations.

An oil and chemical pollution incident plan will be developed and agreed with the relevant authorities. This will set out the measures that would be taken to contain and treat any oil or chemical release and who would be responsible for enacting them. Where possible the project will help reduce the impact of contamination by choosing products (e.g. anti-fouling and lubricants) that are environmentally benign and easily broken down, should accidental release occur.

11.4.2 Operation Phase

11.4.2.1 Collision Risk:

Operational turbine rotors pose a theoretical collision risk to some diving seabird species (Furness *et al.* 2012). There is currently uncertainty as to how diving birds will respond to rotors and therefore it is not known to what extent the theoretical risk will be realised. However, at worst it could lead to injury of death of birds and so this is potentially a serious matter. Only those species that dive to the depths occupied by the rotors of the tidal park will be at risk of collision. The species which are potentially at risk will be identified in the EIA and the magnitude of the potential risk examined. Of the seabird species currently known to regularly use the vicinity of the tidal park, only puffin, common guillemot, black guillemot, razorbill, shag and diver species are likely candidates (Furness *et al.* 2012).

Static infrastructure such as turbine support towers also pose a potential collision risk to seabirds, both underwater to diving birds and above water to flying birds. However, birds commonly experience static obstacles naturally and show very effective avoidance behaviour. Therefore, static infrastructure is unlikely to pose more than a negligible collision risk to birds.

11.4.2.2 Marine Noise:

The effects of marine noise on seabirds during the operation phase are expected to be similar in nature but of smaller magnitude to those described above for the installation phase. Indeed, there is no expectation that the noise generated by the turbines or by maintenance vessels will have any direct effects on marine birds. There is a potential for indirect effects should seabird prey species such as small fish show an adverse response to the marine noise generated by the tidal farm. The effects of marine noise on fish are addressed in Chapter 10.

11.4.2.3 Disturbance:

The effects of disturbance on seabirds during the operation phase are expected to be similar in their nature to those described above for the installation phase. The magnitude and frequency of direct disturbance in the operational phase is expected to be less than during the installation phase because there will be far fewer vessel movements.

The magnitude of passive disturbance, i.e. a general avoidance of the vicinity of the devices, is expected to be greater than during the installation phase as the whole array will be in place. It is possible that some species will show complete avoidance of the array area. Observations of the response of seabirds to other marine infrastructure of a similar scale suggest that the actual magnitude of displacement is likely to be smaller.

The impact of indirect habitat loss on seabirds will be assessed in terms of the potential loss of foraging range. Most of the species likely to be affected are known to have very large foraging ranges (100's or 1000's of km^2, depending on the species). All else being equal, a small 'loss' in a population's foraging range would be considered unlikely to affect its viability, however in this case the relatively close proximity to a major breeding colony (Rathlin Island) will also need to be taken into consideration.

11.4.2.4 Sea bed Habitat Change:

For the same reasons explained under installation, the impacts of sea bed habitat change on birds during the operation phase are also likely to be negligible. During the operation phase no further loss of sea bed habitat is predicted and the colonisation of artificial reef surfaces by benthic marine flora and fauna is expected to increase.

11.4.2.5 Contamination and Pollution:

The range of contamination and pollution issues that might occur and impact on birds during the operation phase are essentially the same as those described earlier for the installation phase. During the operational phase there will be less activity by project vessels and thus the potential for contamination and pollution from vessels will be lower than during the installation phase. There will be a continuing risk of contamination and pollution from the turbine devices themselves. The devices will also pose a continuing navigation risk to shipping and other vessels with the potential to cause a pollution incident.

As in the installation phase, adherence to best practice will mean that the likelihood of a contamination or pollution occurring will be minimised thus making the likelihood of an incident of a magnitude to have a significant impact on seabird populations very low. Furthermore, because the tidal farm is situated in a high energy area, any oil or chemicals released into the marine environment are likely to be relatively quickly dispersed and diluted.

The oil and chemical pollution incident plan referred to under installation impacts would also include the operational phase.

11.4.2.6 Lighting

Lighting on cardinal marker buoys delineating the tidal array could also give rise to disturbance effects on seabirds. Although lighting can potentially cause displacement and disorientation of nocturnally active birds, the extent to which this is likely and lead to adverse effects will depend on the intensity and amount of lighting, and whether or not the birds are already use to lighting from other sources. Seabirds using the vicinity of the tidal farm currently experience lights in the marine environment from various sources, most notably the East Rathlin lighthouse and coastal shipping, and there is no evidence that this has adverse effects.

11.4.3 Decommissioning Phase

Potential effects are predicted to be similar to installation except that since much of the foundation will be left *in situ* the amount of sediment release is likely to be significantly lower than that released during construction.

11.5. Desk Study

A desk study will review published literature and other information sources on birds. This will provide contextual information for evaluating baseline survey results and other information required to inform the assessment on key species, for example, information on feeding ecology, population size, conservation status and response to tidal arrays. The desk review will also identify any significant gaps in the information required for the assessment of the tidal park.

Existing information will be compiled on which seabird species use the area potentially affected by the tidal farm and to which breeding populations they are likely to be linked based on published seabird foraging range metadata (e.g. BirdLife International 2011, Thaxter *et al*. 2012).

11.6 Baseline Surveys

The ornithological importance of the areas potentially affected by the tidal farm will be determined by a programme of survey work. This will include boat-based seabird surveys of the marine area (Appendix 2 for further details of survey methodology).

Before embarking on a programme of shore-based VP behaviour studies, a pilot survey will be undertaken to test the practicalities of this survey method at the site.

11.8 Cumulative Impact Assessment

This is discussed in section 12.6.

12.0 Marine Mammals, Basking Sharks and Turtles

12.1 Introduction

This chapter presents the approach to impact assessment in relation to marine mammals, basking sharks and turtles, to support the development of an application for consent of the Fair Head Tidal Energy Park (FHTEP).

The Chapter has been structured as follows:

- Summary of the legislative requirements relating to marine mammals, basking sharks and turtles to establish the framework under which the impacts to these species need to be assessed;
- A summary of existing data on marine megafauna occurrence at the site;
- An overview of site-specific survey methods as considered appropriate to supplement existing information and enable impact assessment; and
- Possible impacts to marine mammals, basking sharks and turtles and how these will be addressed through the EIA process. Where possible to do so, it will be suggested that impacts which can be concluded at this stage to be of negligible significance are screened out of the EIA.

Pre-scoping consultation has already been held with the DoE MD, NIEA and statutory consultees on the proposed scope and methodology, so that the impact assessment process can be shaped according to the requirements of the regulator and consultees, and ensure that opinions are accounted for at this early stage in project development. It is hoped that this dialogue will continue through the EIA process.

12.2 Legislative Requirements

Species and habitats which are under threat and require conservation action are listed on the Northern Ireland Priority Features List, based on its' status under international (e.g. IUCN Red List, CITES) and national legislation (e.g. UK Priority Species). An initial list of species requiring conservation action was presented in the Northern Ireland Biodiversity Strategy (2002), followed by a more comprehensive list published in March 2004. For marine megafauna addressed in this chapter, the following species are listed as Priority Features and will be assessed through EIA, according to the details available on their current condition and conservation objectives, as available from NIEA resources (e.g. the Northern Ireland Priority Features List website at: http://www.habitas.org.uk/priority/index.html).

- Basking shark
- Minke whale
- Sei whale
- Common dolphin
- Pilot whale
- Risso's dolphin
- Bottlenose dolphin
- Killer whale
- Humpback whale
- Common seal

- Harbour porpoise
- Loggerhead turtle
- Leatherback turtle
- Otter

Under the EC Habitats Directive, species listed on its' annexes are protected by measures to safeguard habitats that are fundamental to the survival of the species, and strict protection measures apply to individuals and populations throughout their range (European Protected Species; EPS), to ensure that Favourable Conservation Status (FCS) of species is maintained. Designation of Special Areas of Conservation (SACs) to protect Annex II species (harbour seal, grey seal, harbour porpoise and bottlenose dolphin) aim to protect habitats that are important for these species. The otter is listed in Annex II and IV of the Habitats Directive although there are currently no coastal SACs with otters as a qualifying feature.

The Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended) (the "Habitats Regulations") implement the requirements of the Habitats Directive, and set out the legislative requirements for European sites which may be affected by the proposal. Based on the information available, there is likely to be connectivity between the development site and a number of SACs. Where there is potential for a 'likely significant effect' on that SAC, appropriate assessment would be required, relative to the conservation measures in place at the site, to ascertain whether the project can proceed without risk of an adverse impact on site integrity. DPME will collate information to support this assessment (generally termed 'Habitats Regulations Appraisal'; HRA). Scoping for HRA will begin following reporting of the first year of survey results.

Further strict protection measures are required for European Protected Species (EPS), listed on Annex IV of the Directive (including all cetaceans). For these species, it is an offence to harm these species, through "deliberate" or "reckless" action resulting in death, injury, harassment or disturbance. These activities are only permissible under licence (and if 3 tests can be met). The term "deliberate" has been interpreted in guidance for the offshore area (JNCC, 2010a) as including indirect but foreseeable actions. In lieu of specific guidance being available for Northern Irish territorial waters, it is proposed that the JNCC guidance is used in undertaking a risk assessment for EPS licensing in relation to the proposed development.

Impacts will be considered relevant to other legislative requirements as they become implemented, such as the designation of possible Marine Conservation Zones (MCZs; to be designated under the Northern Ireland Marine Bill) and the Marine Strategy Framework Directive (MSFD) and its' implementation requirements under the Marine Strategy Regulations 2010. For the latter initiative, descriptors are not well developed, however it is likely that there will be a need to consider the proposed development in relation to the good environmental status (GES) descriptor relating to noise. Marine planning or other regional management measures may be appropriate for managing noise to the levels acceptable in achieving GES, and will necessitate a good understanding of the relative noise produced by marine activities. The detailed noise assessment work proposed will be useful in understanding and managing this risk from the proposed development in this wider context.

12.3 Baseline Information

12.3.1 Summary of Existing Information

Prior to undertaking survey design, a review of available information on marine mammals and megafauna in the area was undertaken. This was to identify which species are likely to be present in the survey area, their likely abundance and seasonality and hence provide understanding of the potential risks to these species. This information is presented in detail within Appendix 2 and is summarised here. Existing information enables a general understanding of the use of the area by marine mammals to be developed, and was gathered from the following sources:

- Reports produced by Agri-Food & Biosciences Institute (AFBI);
- Strategic Environmental Assessment (SEA) of Offshore Wind and Marine Renewable Energy in Northern Ireland;
- Irish Whale and Dolphin Group (IWDG) Database;
- Atlas of Cetacean Distribution in North-West European Waters (Reid, *et al.*, 2003);
- Sea Mammal Research Unit (SMRU), St Andrews University; and
- Other peer-reviewed relevant scientific literature.

Twenty species of marine mammal are known to occur off the coast of Northern Ireland (17 cetacean, 2 seal and 1 otter). Harbour seal, grey seal, harbour porpoise, bottlenose dolphin, common dolphin and minke whale are frequently observed while Risso’s dolphin, killer whale, pilot whales, humpback whales and sea whales have been known to occur occasionally.

12.3.1.1 Basking Shark

Historical information documents basking sharks (*Cetorhinus maximus*) in the waters off Northern Ireland. Basking sharks are highly migratory and closely track seasonal and inter-annual shifts in zooplankton aggregations (Sims & Quayle 1998; Sims *et al*. 2003). These large-scale movements make basking sharks very wide ranging, exploiting both plankton-rich areas out to the edge of the European shelf in addition to tidal fronts that aggregate zooplankton in coastal areas (Bloomfield & Solandt 2007). Tidal fronts around the north Antrim coast sites therefore represent areas where basking sharks are most likely to occur, and they have been reported in large aggregations from around the north Antrim coastline (Dr. A. Mellor, AFBI; *pers comm*) and around Rathlin (AFBI 2009).

In UK and Irish waters the Inner Hebrides, along with the Clyde Sea, Isle of Man and inshore waters around Devon and Cornwall, are known hotspots for basking sharks based on the high densities of sharks found in these areas (Southall *et al*. 2005). Compared to these hotspots, sightings in the North Channel and off the Antrim coast are less common, although historical data suggest a concentration of sightings along the north Antrim coast (ICES block IVb; Berrow & Heardman 1994; Southall *et al*. 2005; Bloomfield & Solandt 2007). IWDG data identify 22 records in the last 10 years in the immediate area of the proposed development site with mainly solitary sightings (IWDG 2013).

Basking Sharks (*Cetorhinus maximus*) are the second largest of the elasmobranches and the largest of any fish found in UK waters. Sightings of basking shark have been made along the Antrim coastline each year and recorded by Irish Whale and Dolphin Group.

There is evidence of 17 species of elasmobranch in Northern Ireland waters, 6 species of ray and 11 species of shark (AFBI 2009). The slow growth rates, late maturity and small litter characteristics of many elasmobranchs render them among the most vulnerable marine fish. Consequently, a number of elasmobranch species present in Northern Ireland waters are considered endangered and included on the IUCN Red List. This species group is therefore one of particular sensitivity to impacts of marine development. High sensitivity species present in Northern Ireland include common skate, white skate, spotted ray and spurdog.

Since 2000 there have been over 100 records of basking shark off the coast of Northern Ireland identifying 149 animals (figure10.1), but these records may not represent the true number of animals present due to unreported sightings and animals that have not been seen. The main area (relative to the proposed current turbine project) where basking sharks have been recorded on the Antrim Coastline is around Rathlin Island with 25 records since 2000.

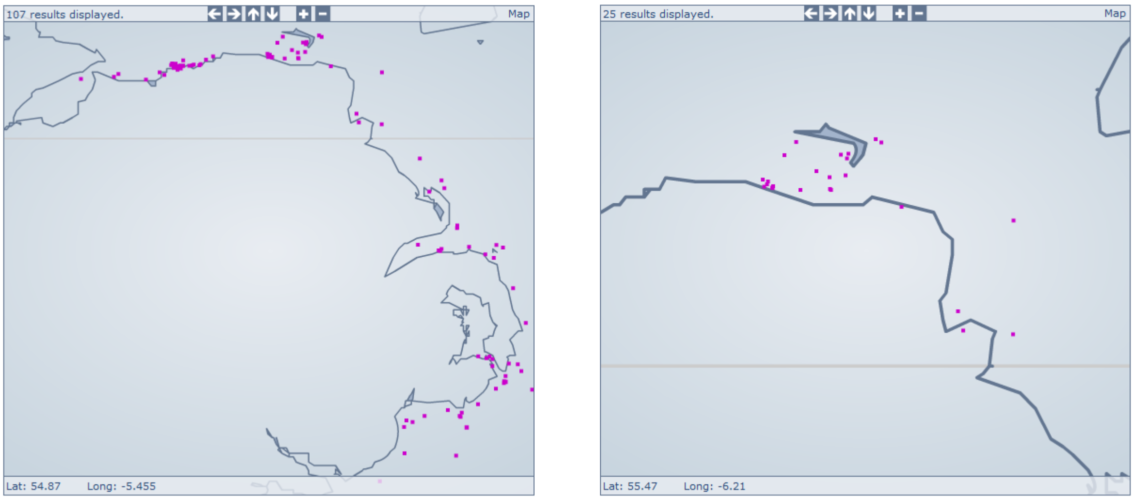


Figure 10.1. Map of Basking Shark records for NI Coastline 2000 – 2013 courtesy of IWDG. All records are validated and available on www.iwdg.ie

12.3.1.2 Pinnipeds - Grey Seal

Grey seals (*Halichoerus grypus*) are widespread in temperate to subarctic waters of the northern Atlantic Ocean, where they typically occur in shelf waters of <200m deep. Grey seals are less numerous in Northern Ireland waters than harbour seals, with the most recent aerial survey reporting 468 grey seals, and annual pup production estimated to be around 100 (Ó Cadhla *et al* 2007; Duck & Morris 2011). The main concentrations of grey seals in August 2011 were in Carlingford Lough, Dundrum, Strangford Narrows, North Rocks, the Outer Ards (Ballywalter and Lisnevin), the Copeland Islands, the Maidens and Rathlin Island (see Duck & Morris; 2011 for further details). In several of these locations grey and harbour seals haul out at the same sites. Over the past decade there has, however, been a substantial increase in the numbers of grey seals recorded in Northern Ireland, particularly in the Outer Ards area. Approximately 20 grey seals were counted at the haulout sites on Rathlin Island in 2011 (Duck & Morris 2011). Large colonies of grey seals are also found along adjacent Scottish coasts including the Treshnish Isles, Colonsay/Oronsay and Islay (SCOS 2012), and seals may regularly move between different haulout sites within a larger area, again emphasising that Northern Ireland seals should be considered within a broader regional framework.

Grey seals feed on a wide range of benthic fish species. They remain on land at the haul-out site to breed (October-November) and to moult (January-March) but otherwise forage at sea, typically within 100 km from the haul-out site. Grey seals show some degree of fidelity to haul-out sites but are also capable of extensive travels, implying that different haul-out sites should not be treated as independent management units.

Grey seals feed mostly on fish that live close to the seabed, but this varies seasonally and regionally. Feeding trips generally take place within 40-50km of haul-out sites and last between one and five days. They occasionally interrupt this pattern of short local trips by travelling longer distances (between 125 and 365 km) to a new haul-out site, which may then become a start point for subsequent feeding trips.

12.3.1.3 Pinnipeds - Common Seal

Harbour (or common) seals (*Phoca vitulina*) are widespread in temperate to subarctic coastal waters of the Northern Hemisphere, where they typically occur in waters of <200 m deep. The UK is home to approximately 36,500 harbour seals, equivalent to 30% of the population of the European sub-species (having declined from approximately 40% in 2002). Scotland now holds approximately 80% of the UK population, with 15% in England and 5% in Northern Ireland (Duck & Morris 2011).

Aerial surveys along the entire Northern Ireland coast in 2011 counted 948 harbour seals, down from 1,248 seals in 2002 (SCOS 2012); harbour seal numbers in Northern Ireland have been declining at an average annual rate of 3.0% (95% c.i. 2.4% - 3.7%) since 2002 (Duck & Morris 2011). The main concentrations of harbour seals were in Carlingford Lough, Dundrum, around Minerstown, Strangford Narrows, the Outer Ards (Ballywalter and Lisnevin), the Copeland Islands, Rathlin Island and in Lough Foyle (Duck & Morris 2011; SCOS 2012). Approximately 100 harbour seals were counted at the Rathlin Island haulout sites in 2011. Large colonies of harbour seals are also found along adjacent Scottish coasts including the Mull of Kintyre, Isle of Arran and Islay (SCOS 2012), and seals may regularly move between different haulout sites within a larger area, emphasising that Northern Ireland seals should be considered within a broader regional framework.

Strangford Lough represents a significant proportion of common seals in Ireland. Recent data from Strangford Lough suggest that common seal counts have declined by 3% per annum (95% CI: 1-5%) producing a 35% decline over the period 1994 to 2006 (SCOS 2007). The UK common seal population is generally in decline (SCOS 2008). Recent tracking studies of seals tagged within Strangford Lough have suggested that the population feeds mainly in the Irish Sea and that seals that occur within the Lough also regularly haul out at sites out-with the Lough.

Harbour seals show a degree of fidelity to haul-out sites in particular areas (Cunningham *et al.,* 2009) but may switch haul-out sites at least occasionally, possibly under influence of prey movements (Thompson *et al.,* 1994). They often remain relatively close (generally within 50 km) to the haul-out site for foraging and show fidelity to specific underwater locations (Thompson *et al.* 1994; Cunningham *et al.* 2009).

Harbour seals feed upon a wide range of benthic fish and invertebrates, and prey selection appears to be heavily influenced by local habitat availability (Tollit *et al.,* 1998). Pupping occurs in June-July while moulting takes place from August to September, both of which necessitate hauling out for extended periods.

Data available from SMRU including at-sea seal density maps (for grey and harbour seals) such as are being produced as a deliverable of Scottish Government Marine Mammal Scientific Support Research Programme MMSS/001/11, will be used as they are appropriate to the development area. Grey seal (*Halichoerus grypus*) telemetry data from 1991-2011 & harbour seal (*Phoca vitulina*) telemetry data from 1991-2012 were combined with count data from 1988-2012 to produce at-sea & hauled-out estimated density & associated confidence intervals. The maps show broad-scale population-level species distribution around the UK, at a fine-scale resolution of $5km^2$.

12.3.1.4 Cetaceans

The cetacean fauna of Northern Ireland is considered to be moderately rich (Reid *et al*. 2003; O'Brien *et al*. 2009; IWDG 2013). More than 15 species of cetaceans have been recorded in the nearshore waters of Northern Ireland (within 60 km of the coast), although only harbour porpoise (*Phocoena phocoena)*, short-beaked common dolphin (*Delphinus delphis)*, and bottlenose dolphin (*Tursiops truncatus)* can be considered as frequently occurring through much of the year, and minke whale (*Balaenoptera acutorostrata)* occurring regularly as a seasonal visitor. Risso's dolphin (*Grampus griseus)* and killer whale (*Orcinus orca)* can be considered uncommon visitors (Reid *et al*. 2003; O'Brien *et al*. 2009; IWDG 2013).

Following the results of the baseline survey, the EIA approach will be refined to focus on the species which are likely to be occurring at the project area. A summary of the baseline of the species which may commonly occur is presented below, recognising that other species may need to be addressed in the EIA.

For some species, it may not be concluded that they would never occur at the site, but their occurrence would be sufficiently low that a) any interaction resulting in impact would be likely to be insignificant and b) it would be difficult to undertake a meaningful assessment. We would seek the input from DoE MD on this scoping when survey information has been reported.

12.3.1.5 Harbour Porpoise

Harbour porpoises (*Phocoena phocoena*) occur in cold temperate to subarctic waters in the Northern Hemisphere and are by far the most commonly encountered cetacean in Scotland (Goodwin and Speedie, 2008). Harbour porpoises are distributed widely in the North Channel and offshore from the Antrim coast, but there is relatively little information on small-scale harbour porpoise abundance and distribution at the proposed site. IWDG data identify 73 records in the last 10 years in the immediate area of the proposed development site with groups as large as 24 individual animals (IWDG 2013). Surveys in coastal waters off Northern Ireland in July 2004 estimated harbour porpoise abundance and mean density as 387 individuals (95% CI = 170-877) and 0.387 individuals/km^2, respectively (Goodwin & Speedie 2008). During the most recent large-scale SCANS-II survey (SCANS-II 2008) across most of the European continental shelf area, the northern coast of Northern Ireland around the proposed site was surveyed together with western Scottish waters up to Cape Wrath and outwards to the Outer Hebrides (Survey block N). Across this entire area, estimated porpoise abundance was 12,076 with an average estimated density of 0.3943 animals/km^2.

Coastal waters of Northern Ireland have received attention as a possibly significant area for harbour porpoise (e.g. Evans & Wang 2008; Clark *et al*. 2010). In a UK first, in 2012 the Skerries and Causeway candidate SAC was proposed with harbour porpoise as a “Qualifying Feature”, suggesting that this area is important to large numbers of harbour porpoises.

Harbour porpoises in Scottish waters are known to forage on a range of small benthic and pelagic shoaling fish species, particularly sandeels (Ammodytidae) and small gadoid species such as whiting (*Merlangius merlangus*; Santos *et al.,* 2004).

At present it is unclear whether porpoises either target or avoid marine habitats subject to high rates of tidal flow, such as found within the proposed development site. Studies carried out in numerous sites in UK waters and elsewhere (e.g. Calderan, 2003; Pierpoint, 2008, Marubini, *et al*., 2009) all indicate that porpoises are found in elevated densities in areas of high tidal-streams. In marked contrast, however, Embling *et al.* (2010), analysed results from dedicated cetacean surveys from the southern Inner Hebrides, and found that porpoise distribution was best explained by tidal currents with the higher densities predicted in areas of low current. A subsequent study encompassing the entire Hebrides area (Booth, 2010) found that depth (especially waters between 50-150 m), steep slopes and proximity to land were all important in explaining areas of high porpoise density, but that relationships with current speed were less important. Further work is therefore necessary to clarify the relationship between harbour porpoise distribution and strong tidal currents, particularly at small spatiotemporal scales.

12.3.1.6 Bottlenose Dolphin

Bottlenose dolphins in the North Atlantic appear to occur in two forms, coastal and offshore. The better known coastal form is locally common in the Irish Sea (particularly Cardigan Bay) and off north east Scotland (particularly the inner Moray Firth), the west coast of Ireland (e.g. the Shannon estuary, co. Galway/Mayo) and in smaller numbers in the Hebrides (west Scotland) and off south west England. Little is known about the offshore form of bottlenose dolphins, including the relationship between the offshore and coastal forms. More detailed studies in the North West Atlantic suggest that inshore and offshore populations are ecologically and genetically discrete (Hoelzel *et al*. 1998).

During the most recent large-scale SCANS-II survey across most of the European continental shelf area, the northern coast of Northern Ireland around the proposed site was surveyed together with western Scottish waters up to Cape Wrath and outwards to the Outer Hebrides (Survey block N; SCANS-II 2008). Across this entire area, estimated bottlenose dolphin abundance was 246 with an average estimated density of 0.080 animals/km^2. A more precise assessment of bottlenose dolphins in the Hebrides (the nearest resident population to the north Antrim coast) suggests that in total there may be approximately 45 (95% C.I.: 33-66) bottlenose dolphins in inshore waters, split between a widespread Inner Hebrides group of approximately 30 animals, and a localised group of approximately 15 animals around Barra in the Outer Hebrides (Cheney *et al*. 2013). It is not clear whether either group strays into Northern Irish waters.

While effort-related sightings are few in the northern Irish Sea, the species is regularly sighted in summer off the Galloway coast of southwest Scotland, around the Isle of Man and north Anglesey (Reid *et al*. 2003). Bottlenose dolphins are also recorded in small numbers around the Northern Ireland coast with peak numbers and frequency of sightings in April, and August to September. Good sighting localities are around Copeland Island and the entrance to Belfast Lough (IWDG 2013). IWDG data identify 19 records in the last 7 years in the immediate area of the proposed development site with groups as large as 50 individual animals (IWDG 2013). Several bottlenose dolphins sighted along the north Antrim coast have also been identified at numerous locations around Ireland, suggesting the presence of a small highly mobile population in coastal Irish waters (O'Brien *et al*. 2009). This suggestion is consistent with data from the SCANS II survey, which reported abundance estimates of bottlenose dolphin of 313 individuals (CV=0.81) there has been a slight decrease in signs of otter activity over the last 20 years. for coastal Ireland (SCANS-II 2008). Recently, connectivity was confirmed between bottlenose dolphin populations in the Moray Firth (eastern Scotland), the Inner Hebrides and Irish waters, implying that these populations are not isolated from each other (Robinson *et al*. 2012).

12.3.1.7 Short-beaked common dolphin

The short-beaked common dolphin (*Delphinus delphis*), is primarily seen in the far south of the Irish Sea, particularly in summer (Reid *et al*. 2003; SCANS-II 2008; O'Brien *et al*. 2009). While this species has been recorded in the North Channel and waters of County Antrim (IWDG data identify 2 records in the last 10 years in the immediate area of the proposed development site), sightings are mainly offshore (IWDG 2013).

12.3.1.8 Minke Whale

Minke whales (*Balaenoptera acutorostrata*) are the smallest and most abundant of the baleen whales encountered around the UK coast. They appear to favour areas of upwelling or strong tidal currents and are usually seen singly or in pairs but sometimes aggregate in greater numbers in areas where prey is abundant (Reid *et al*. 2003). Within UK waters, minke whales are most frequently sighted in the western central-northern North Sea, and west of Scotland around the Hebrides. Minke whales are occasionally observed in the North Channel and waters north of Co. Antrim, occurring mainly between July and October (IWDG 2013). IWDG data identify 7 records in the last 10 years in the immediate area of the proposed development site, mainly as solitary animals.

12.3.1.9 Otters

The European otter (*Lutra lutra*) is a semi-aquatic mammal, which occurs in a wide range of ecological conditions, including inland freshwater and coastal areas. Populations in coastal areas utilise shallow, inshore marine areas for feeding but also require fresh water for bathing and terrestrial areas for resting and breeding holts. In general, otter distribution in Northern Ireland is concentrated inland with low occurrence at coastal sites (Preston *et al*., 2006). Northern Ireland has a healthy population of otters at present.

12.3.2 Site-specific Data Collection on Marine Mammals, Basking Sharks and Turtles

Survey activities are underway at the Fair Head site, according to a survey methodology and programme (Appendix 2) which has been reviewed by NIEA (SRSL and NRP, 2013). This proposes a combination of vessel-based visual and towed passive acoustic methods, deployment of a moored acoustic detector and shore-based observations. These complementary methods have been designed to obtain adequate information on the presence and distribution of marine megafauna at the development site to enable impact assessment. Regulator views on the survey programme have also been incorporated into the proposal.

Vessel based surveys will follow the transect layout proposed in Figure 12.1. While surveys will be targeted to coincide with sea conditions suitable for visual sightings, this may not always be possible. The survey vessel will therefore be towing a hydrophone array (with a minimum of 3 elements) designed to detect, and where possible, localise the vocalisations of echolocating odontocete cetaceans (dolphins, porpoises and other toothed whales). This passive acoustic monitoring (PAM) system provides a second means of detecting these animals and will also improve odontocete detection probabilities in sea states exceeding Beaufort 3 (up to around 6) which is not realistic with visual methods only.

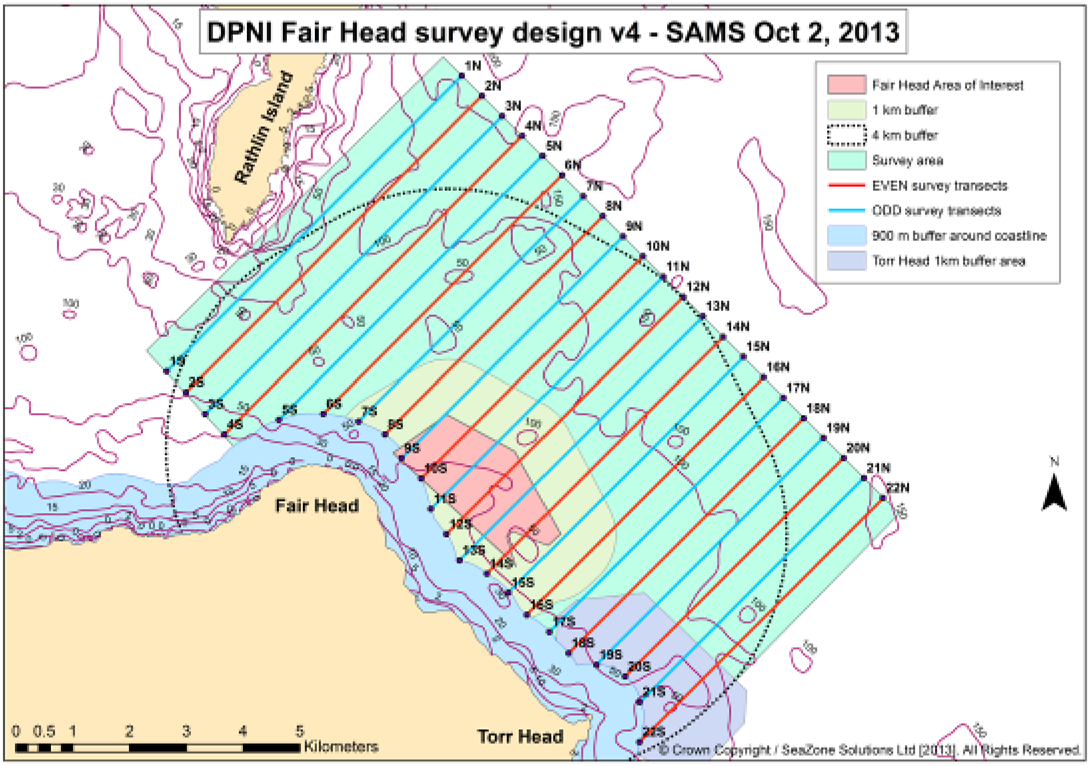


Figure 12.1: Proposed Visual/acoustic Survey Design

It is also proposed to utilise moored acoustic devices (C-PODs) to provide an important complement to results from ship-based surveys, which are essentially "snapshot" observations across a wider area. Although C-POD data, by themselves, cannot be used to estimate absolute densities of porpoises (not all animals vocalise constantly, not all are facing towards the detector when they do vocalise, and it is impossible to identify multiple animals vocalising concurrently) and coverage around a mooring is spatially limited (a few 100m for porpoise clicks, up to 1km for dolphin clicks), they do provide a long-term dataset of habitat usage that is impossible to obtain by other means (visual observations are not possible at night or in poor weather, and survey vessels only provide a snapshot).

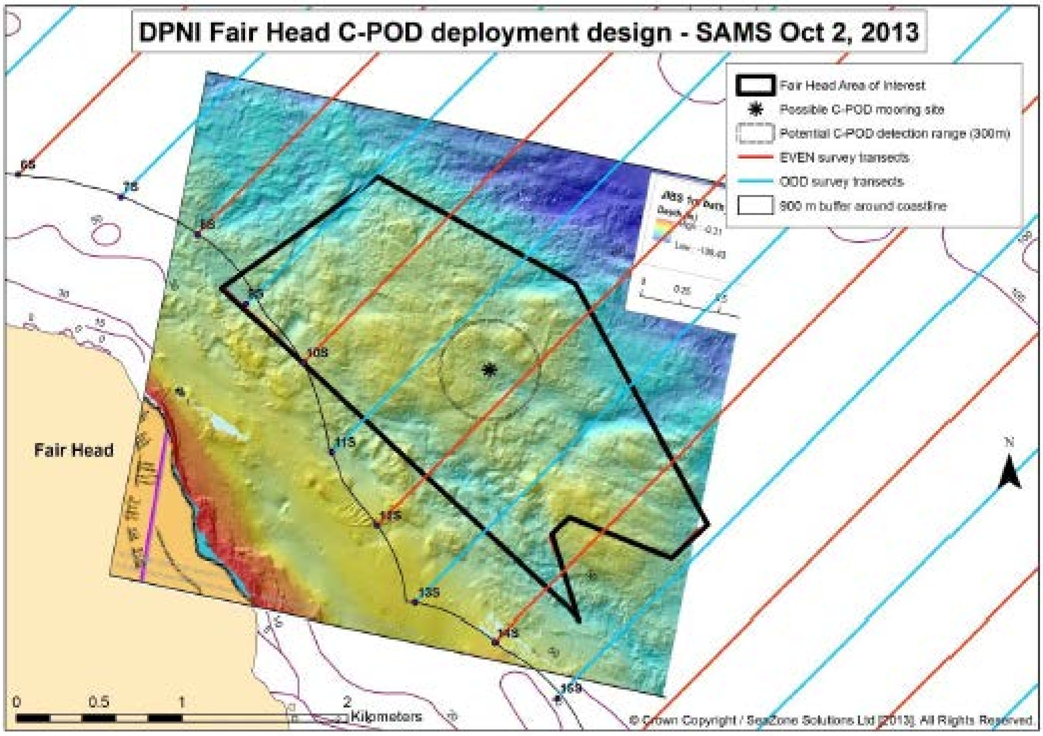


Figure 12.2: Proposed mooring location for C-POD deployment within the Fair Head Area of Interest (SRSL and NRP, 2013).

Dedicated shore-based visual surveys from Fair Head, using binoculars, will provide additional information on small-scale variation in marine mammal distribution, particularly in waters closer to shore where vessel movement may be constrained.

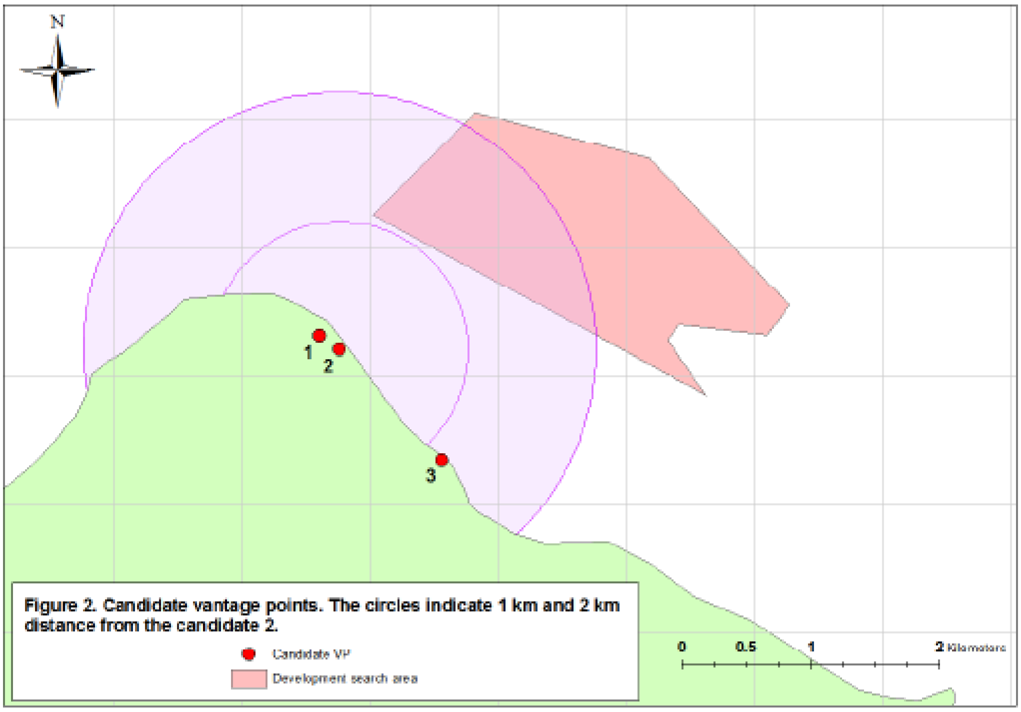


Figure 12.3: Vantage points for shore-based observations of marine mammals (and birds).

It is intended that the combination of data collection methods present a sufficiently comprehensive study to understand detailed usage of the site by marine mammal, turtle and basking shark species. There are acknowledged challenges with obtaining survey data which is sufficiently robust to enable impact assessment, particularly where impact assessment involves quantitative modelling exercises (e.g. encounter risk modelling). It is therefore essential that any survey bias, difficulties and uncertainties are accounted for when utilising the results of the study and this uncertainty will be fully communicated during impact assessment.

12.4 Potential Impacts

Potential impacts arising from the different phases of development which will be considered in EIA are presented in Table 12.1.

CONSTRUCTION (temporary)		
Impact		Effect
1	Injury and disturbance due to noise and presence of construction vessels and activities	Potential for injury and disturbance of marine mammals, leading to displacement from the area (with potential for habitat exclusion and barrier effects).
2	Disturbance from haul-out sites	Potential for seals to be disturbed from haul out sites during construction operations.
3	Collision risk with construction vessels (including ‘corkscrew seal’ issue)	Potential for death / injury through interaction with installation vessels, including the ‘corkscrew seal’ issue.
4	Increased turbidity	Potential for increased turbidity through elevated levels of suspended sediments, with consequent effects on behaviour of marine mammals.
5	Accidental release of contaminants	Potential for release of materials required during construction with consequent effects on water quality.
6	Indirect impacts of changes to prey resource	Possible impacts on marine mammal predators due to changes in food source such as reduction in prey availability.
OPERATION (permanent over the lifetime of the project)		
Impact		Effect
7	Injury and disturbance caused by operational noise	Potential for injury and disturbance leading to behavioural impacts.
8	Displacement leading to habitat exclusion and barrier effects	Potential for noise or presence of the array to displace mammals from the area leading to habitat exclusion or barrier effect for transiting individuals.
9	Collision with operating turbines	Potential for injury or sub-lethal effects through collision with the development.
10	Collision risk with maintenance vessels	Potential for death / injury through interaction with maintenance vessels.
11	Electromagnetic Fields (EMF)	Possible effects on behaviour due to the EMF emitted from the inter-array and export cables.
12	Accidental release of contaminants	Possible effects following accidental release of contaminants.
13	Indirect effects on prey populations	Possible impacts on marine mammal predators due to changes in food source such as reduction in prey availability.
DECOMMISSIONING (temporary)		
14	Comparable to those presented in the construction phase.	

Table 12.1: Summary of Potential Impacts to Marine Mammals & Basking Sharks.

12.4.1 Construction and Operation

12.4.1.1 Injury and disturbance due to noise

There is potential for construction activities associated with the installation of the turbine array, inter-array cabling and cabling to the landfall, to cause behavioural changes in marine mammals present in the area. Noise would arise from the vessels present at the site for preparation works (pre-installation and foundation preparation), foundation, turbine and array installation activities, and commissioning.

Anthropogenic sound has the potential to mask biologically significant sounds such as echolocation (affecting navigation and foraging capability), communication vocalisations, or other relevant environmental sounds, and may result in disruption of behaviour, displacement from noisy areas, physiological injury /stress, or altered distribution patterns.

EIA will focus on the specific construction activities associated with the proposed project, and consider these in relation to the occurrence and distribution of potentially sensitive species indicated by the baseline survey. This will aim to establish the likely worst-case auditory characteristics of the construction works (using data available on the likely vessels and techniques to be used) and related to the potential hearing sensitivities of marine mammal and megafaunal species so that any adverse impacts can be established. Impact assessment will be considered in the particular context of the potential licensing requirements for cetaceans and basking sharks (under the EPS Licensing requirements).

12.4.1.2 Disturbance from haul-out sites

Physical disturbance of seals hauled out on land can occur during installation of devices and cables, as a result of the presence of installation vessels and equipment, and the noise they produce, in the vicinity of operations at the array or along the cable route. This would be most significant for breeding and moulting seals, hauled out on the coast and on intertidal banks.

Disturbance of breeding seals into the water may result in separation of pups from their mothers, temporarily or permanently, as has been observed in harbour seals elsewhere (Osinga *et al.*, 2012). Moulting seals also spend more time out of the water to retain heat while shedding their fur, and if scared into the water they may lose condition as a result of additional energetic costs. A secondary risk is possible loss of condition through repeated disturbance of pups during suckling. Outwith the breeding season, disturbance of seals that are undertaking the annual moult may result in increased energetic costs and a consequent loss of condition.

The location of haul-out sites in relation to the proposed development will be considered to determine whether an effect is likely. This requires definition of the cable route as the activities which will pass closest to the coast. Where an effect is of concern, mitigation measures such as timing of activities would be considered.

12.4.1.3 Collision risk with vessels (including ‘corkscrew seal’ issue)

Vessels present during construction, or maintenance during the operational phase, present a risk of collision with marine mammals, involving interaction with the hull of the vessel or propellers. Risk of interaction is affected by vessel type and speed, the sounds emitted by the vessel relative to ambient noise, local weather conditions and marine mammal behaviour (Laist *et al*. 2001). Vessels travelling at 7 ms^{-1} or greater present the greatest risk of mortality or serious injury through collision (Laist *et al*., 2001).

Recently there have been discoveries (including at Strangford Lough) of seal carcasses displaying a spiral laceration which may be consistent with a seal being drawn through propellers housed within cylindrical nozzles or other thrust-augmenting devices (e.g. kort nozzles or azimuth thrusters; Bexton *et al*., 2012). These are used in the dynamic positioning systems of vessels used in association with a number of activities within the marine environment where maintaining a position without anchoring is required (e.g. marine construction). This will be assessed in relation to the proposed construction activities at the site. Understanding of the potential extent of the problem remains difficult, as unaccounted carcasses may not have been recovered; to date, no direct links have yet been made to specific activities or vessel types.

Recent agency advice (SNCAs, 2012) suggests that it may be appropriate to apply mitigation to operations within 4km of significant haul-out sites / SACs, and that this may include timing of operations and monitoring the area during operations. Potential mitigation, if required, will be addressed in the EIA such as timing of activities and propeller guards.

12.4.1.4 Increased turbidity

Installation (and decommissioning) activities may directly disturb seabed sediments, or result in the release of sediments from drilling activities, leading to temporary increase in turbidity in the water column. Seals are generally assumed to be sensitive to poor visibility (e.g. Hobson, 1966; Scottish Executive, 2007) and possible impacts on foraging effectiveness and individual interaction will be investigated. Observations of seals gathered through visual survey and other information relating to seal movement (such as tagging data available from SMRU) will be informative as to the most likely behaviour at the site (i.e. whether foraging or transiting), supporting assessment of the impacts of any decrease in sensory ability due to increased turbidity.

12.4.1.5 Accidental release of contaminants

There is small risk of the accidental release of contaminants during the installation phase and operation, including diesel fuel, oil hydraulic fluids etc, which may have toxic effects on marine megafauna. This will be assessed along with proposals for best practice risk reduction methods to be included as mitigation.

12.4.1.6 Indirect impacts of changes to prey resource

There is the potential for indirect effects on marine mammals, through impacts on prey resources (fish) as a result of the presence of the installation vessels and equipment (and associated noise) during operations. In addition, the noise generated by drilling may cause a disturbance impact and the consequent effects of this on marine predators will be considered (this will be considered in conjunction with chapter 10 Fish and Shellfish and associated EIA. The importance of the area as foraging habitat for key species such as harbour porpoise and seal species will be used in supporting assessment of indirect impacts through effects on prey.

12.4.1.7 Injury and disturbance caused by operational noise

Noise produced by the array during operation is likely to cause behavioural changes to marine species which occur in the area. The extent to which this effect occurs depends on a number of factors, including the presence and behaviour of species at the site, the noise levels produced by the array, the extent at which it is audible above background noise (species-specific), etc). As a key impact of concern in the development of tidal energy projects, a methodology has been developed for addressing this impact which will be used in the EIA.

Details of how noise levels will be measured and assessed are defined in Chapter 20 on Noise.

The results of the ambient noise study and data analysis, along with the operational noise modelling will form the basis of assessment of potential detection and impacts by marine megafauna. Assessment of the likely responses to noise depends on the availability of information regarding hearing sensitivity of individual species (i.e. an audiogram). Sufficient audiogram information exists for species which are likely to be present at the site, to support assessment. This information would be treated with appropriate caution, as methods of retrieval of audiograms may differ and therefore not be directly comparable. Using information on potential zones of impact, the potential for injury or disturbance will be assessed, including whether there is risk of an offence occurring (as per JNCC guidance on EPS licensing). The assessment of noise impacts will be considered in relation to the assessment of potential collision risk, as either attraction or evasion due to noise produced during operation, at an array or turbine level, would influence the potential for collision events to occur.

12.4.1.8 Displacement leading to habitat exclusion and barrier effects

Aversive reactions to operational noise outlined above, or perceptions of infrastructure may result in displacement of species from the site, and potentially present a barrier to transiting individuals. Devices may exclude mammals from foraging habitats, nursery or breeding areas, migration / travelling routes and socialising areas.

At tidal locations, movement of animals is generally associated with the movement of the water volume and therefore the spatial extent of any displacement impact will be spread over an elongated area extending upstream and downstream of the array. The degree of this effect will be directly influenced by the breadth of the aversive stimulus relative to the width of the habitat. The magnitude of the effect will therefore be greater in constrained areas such as within tidal narrows, rather than open tidal stream sites (such as the waters off the north Antrim coast). However, it will be critical to consider the importance of the area for migratory species such as basking shark, and foraging (harbour porpoise and seal species).

Results from Strangford Lough demonstrate that there has been a long term change in usage of the site around the turbine, and the most up to date results of the monitoring work will be used to inform this assessment. Survey information will support assessment of spatial preferences across the site, which may inform mitigation strategies through array location and design, if deemed necessary.

12.4.1.9 Operation: Collision with operating turbines

Potential collision between marine mammals and basking sharks and turbine blades as animals move through the tidal energy site may result in injury or death to individuals. Collision risks between marine mammals and tidal turbines can be considered as a function of encounter rates, modified by probabilities of 1) animals avoiding a collision just before impact ("evasion", or "near-field avoidance") and 2) animals avoiding the larger area surrounding the devices altogether ("avoidance" or "far-field avoidance"). To support assessment of possible collision risk, a 3-dimensional model for estimating encounter rates between marine mammals and tidal turbines has been developed, building on previous modelling approaches quantifying potential capture events between aquatic planktonic predators and their prey (Gerritsen and Strickler, 1977) that was adapted for the essentially passive collision dependent predation mechanism of medusa feeding on fish larvae (Bailey and Batty, 1983).

The model considers, as far as is possible, the underwater movements of the species deemed to be at risk, as the trajectory of approach and activity of the animal may affect the potential for collision. For example, this will include consideration of the dive profiles of seals associated with the general behaviours of foraging or transiting.

A full collision model is not yet possible because too little is known about the actual responses of animals to the presence of turbines. As undertaken for Meygen and for West of Islay (SRSL, 2013), an encounter risk modelling exercise will be undertaken to form the basis of assessment of potential collision risk impacts. The model is currently under development in co-ordination with regulators and statutory consultees in Scotland and therefore aims to provide the best available method of assessing this risk.

Results will be interpreted in combination with the operational noise modelling outlined above, as the extent to which the devices may be detected above background noise is likely to influence the extent to which individuals will alter their behaviour and reduce the risk of collision.

The significance of possible collisions, which unless further evidence arises would generally be considered to be equivalent to mortality, will be species-specific and carried out with regard to legislative controls and available population information.

Assessment will also be undertaken of the potential for entanglement of marine megafauna with project infrastructure, such as cables, chains and power lines. SRSL is undertaking a study commissioned by SNH to investigate the risk of entanglement, defining which metrics are significant in determining risk and whether there is a threat to individuals. This will be available to support assessment of this impact.

12.4.1.10 Electromagnetic Fields (EMF)

Electromagnetic fields (EMF) produced by cables associated with the project have the potential to cause behavioural responses in marine mammals and basking shark. Matrices of cables within arrays may produce a more concentrated EMF effect than individual export cables. There is limited evidence available regarding the impact, with possible effects reported for benthic elasmobranches Gill *et al.*, (2009) and Kimber, *et al.*, (2011) but not for marine megafauna. Although also taxonomically classed as an elasmobranch, the basking shark is a pelagic species and therefore considered to be of low sensitivity to EMF.

There is no apparent evidence that existing electricity cables have influenced migration of cetaceans. Migration of the harbour porpoise in and out of the Baltic Sea necessitates several crossings over operating subsea HVDC cables in the Skagerrak and western Baltic Sea without any apparent effect on its migration pattern (Walker, 2001). Recent studies suggest that some cetaceans might possess some form of electroreception, but the implications regarding sensitivity to artificial EMF remain poorly understood to date (Czech-Danal *et al.*, 2012). There is no evidence that seals are sensitive to electromagnetic fields.

The strength of both magnetic and electric fields decays rapidly with horizontal and vertical distance from the cables, and is therefore dependent on the depth to which export cables are buried. Water depth at the project site varies from 25 – 130m LAT, and as the greatest proportion of animal movements through the site would occur in the upper part of the water column, exposure is reduced. Further, due to the risk of cable abrasion and damage due to the high current and constantly reversing flow, cables will be protected through burial, further reducing emission of EMF. Given the likely scale of propagation of EMF, it is likely that any effects which may occur would be highly localised but this will be investigated in detail through EIA.

12.5 Key Guidance Documents

All available and relevant scientific literature relating to the potential impacts to these species will be analysed. Much of these documents have been developed for project development in Scotland but are likely to also be relevant here. In particular, the publications below would be referred to:

- Pentland Firth and Orkney Waters Enabling Actions Report: Review of current knowledge of underwater noise emissions from wave and tidal stream energy devices. Report commissioned by The Crown Estate, August 2013;
- Consenting, EIA and HRA Guidance for Marine Renewable Energy Developments in Scotland (EMEC and Xodus, 2010);
- The protection of European protected species (EPS) from injury and disturbance. Guidance for the marine area in England Wales and UK offshore marine area (Joint Nature Conservation Committee (JNCC, 2010a); and
- Guidelines for Ecological Impact Assessment in Britain and Ireland, Marine and Coastal (Institute for Ecology and Environmental Management, 2010).

12.6 Cumulative Impact Assessment

Cumulative impact assessment (CIA) in the context of EIA, is considered to mean the assessment of the impact of the project on a receptor, where there are multiple stressors in action. This includes assessment of effects arising from sources outwith the project that could affect the predicted baseline, thereby contributing to an overall effect. This includes multiple projects of the same type, other activities and environmental stressors.

In-combination effects assessment is terminology specific to the HRA process, to consider ‘other plans and projects’ along with the proposed project, and the risk of an adverse impact being incurred through ‘in-combination’ effects. This will be presented in the HRA report.

The scope of cumulative assessment is defined by the spatial and temporal scale of the impact being assessed, relative to the activities which are occurring / proposed and the geographical range of species at risk. In general, it is necessary to consider any project which is in the planning system, i.e. those for which formal scoping exercises has begun, where information is publically available. For projects at an early stage in development, limited information will exist and therefore subjective assessments will be made. Within a reasonable geographical range of the species identified as being at risk of potential environmental impact from the Project, a number of activities were identified as relevant to CIA for marine mammals:

- Torr Head tidal energy site (TVL)
- Petroleum operations off Rathlin Island (Providence Resourcing)
- West Islay Tidal Energy Park (DPME and DEME)
- Irish Sea Round 3 Wind Farm (Celtic Array Ltd)

For aspects where there is an issue of cumulative concern, it may be necessary to consider the relative impacts of the Torr Head and Fair Head tidal energy projects. Depending on device type, collision risk and the impact of operational noise are likely to be the most significant risks at both the Torr Head and Fair Head tidal energy developments, as these will exert an influence over the lifetime of the projects. It is likely that during the consenting process, these topics will feature heavily in understanding cumulative risk to marine mammal species and may present a challenging task in determining allowable capacity across the strategic area. To do this, there is a need for consistency in the methods of impact assessment, so that the results can be considered cumulatively.

12.6 Data Gaps and Uncertainties

There is a notable lack of evidence on the impacts of tidal energy devices due to the limited deployment of commercial arrays. There is a wealth of information available from the Strangford Lough monitoring activities, and the testing of prototype devices at the EMEC test centre. However, due to the increased scale of development, EIA for new commercial arrays will depend to a large extent on the use of predictive modelling tools and the application of expert judgement. SRSL are at the forefront of developing the science to inform understanding of impacts of marine renewables on marine mammals and their input and advice will be essential to understanding the realities of the risks from the proposal. However, as previously stated an open EIA process between the consenting authorities, statutory consultees and all relevant parties, to ensure that the approaches taken are sufficient to meet requirements is recommended.

12.7 Mitigation and Monitoring

As the EIA progresses, we will consider possible mitigation techniques as necessary, to reduce identified risks to acceptable levels. Mitigation measures will be considered on the basis of effectiveness and acceptability to consultation authorities.

A monitoring plan will be required and this will be developed according to the risks identified. The monitoring plan will be developed through discussion with the regulatory authorities to ensure that the purpose of the monitoring is agreed; that objectives are set according to consensus on the ability to detect change attributable to the development; and that this is considered according to a reasonable cost / scale of studies, proportionate to the level of risk identified. This will be programme defined over an appropriate timescale, with defined reporting intervals.

Section 4: Human Environment

13. Commercial Fisheries and Mariculture
14. Marine and Coastal Historic Environment
15. Cables and Pipelines
16. Military Exercise Area
17. Disposal Sites
18. Commercial Shipping and Navigation
19. SocioEconomic
20. Noise
21. Electromagnetic Field
22. Landscape and Seascape

Photographer - Kathleen McNeilly

13.0 Commercial Fisheries and Mariculture

13.1 Introduction

Commercial fishing is an important industry in the inshore areas of Northern Ireland. Within Northern Ireland, the main species targeted by the inshore fleet are crab, lobster, scallops, queen scallops, mussels, cockles, whelks, Palaemon prawns and Nephrops.

13.2 Governance

In Northern Ireland, the inshore sector is governed by the Department of Agriculture and Rural Development (DARD) whose Fisheries and Environment Division has the responsibility of preparing and enforcing all fisheries regulations, both for the offshore and inshore sectors. Whilst previously this did not include the foreshore, the Fisheries (Amendment) Act (Northern Ireland) 2001 gave DARD powers to regulate fisheries up to the high water mark.

The total number of vessels (both offshore and inshore) within the Northern Ireland fleet over the last 10 years has averaged around 340. Following a dip in 2003, the number of fishing vessels has been increasing steadily (Figure 13.1) with the inshore sector seeing considerable growth in recent years. This increase in the inshore sector is partly as a consequence of the increased pressure on the offshore fleet which has seen fishermen moving from offshore fisheries to inshore fisheries such as pot fishing and scallop dredging. With the Northern Ireland inshore fishery being worth in excess of £4 million in 2010, the move is attractive to fishermen who are being constrained by tight regulations and reduced quotas.

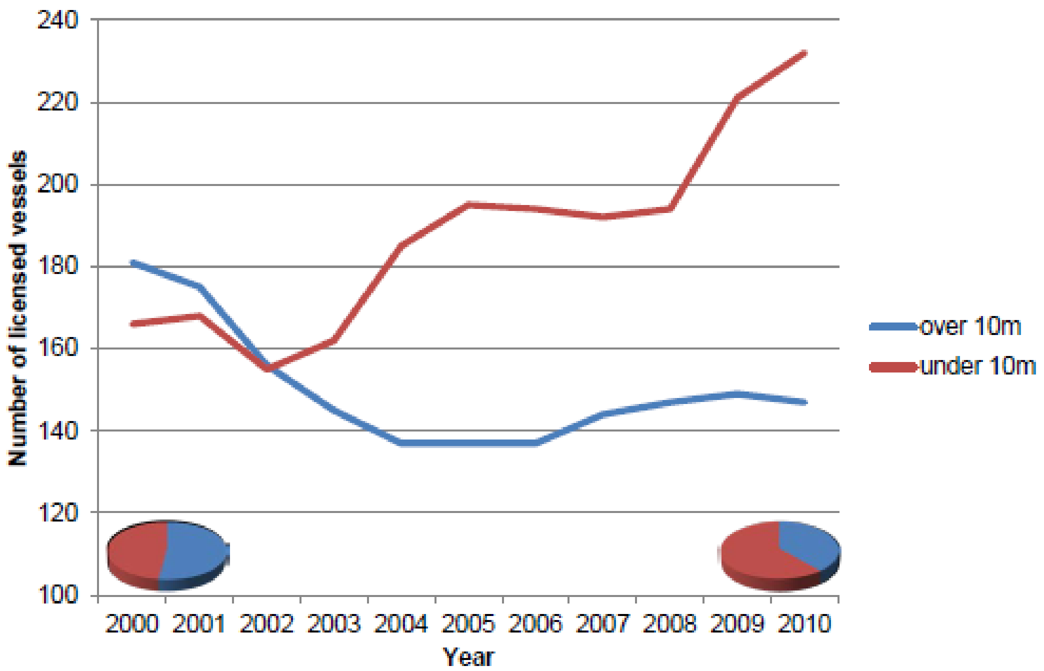


Figure 13.1. Trends in the Northern Ireland Fishing Fleet.

13.3 Current Knowledge

A preliminary desk based assessment has gathered data from the NI SEA which in turn has referenced data from the following sources.

- DARD/MFA fisheries landings statistics;
- Report of the International Bottom Trawl Survey Working Group (IBTSWG) ICES IBTSWG REPORT 2012;
- The Rising Tide - A Review of the Bottom Grown (BG) Mussel Sector on the Island of Ireland;
- Northern Ireland Fleet Futures Analysis (2004-2013) - Methodology and Results (currently being updated);
- Sustainable Mariculture in northern Irish Lough Ecosystems (Smile) report;
- Inshore fisheries review AFBI 2013; and
- SEA 6,7 and UK offshore energy SEA technical reports.

The inshore sector is characterised by the change in the Northern Ireland fleet which has now become dominated by smaller vessels (Figure 13.2). Whilst in 2000 52% of the fleet were greater than 10m in length, by 2010 this had dropped to 38% meaning that three in every five Northern Ireland fishing vessels are now less than 10m in length. With this change in length there has also been a change in the structure of the ports with more fishermen fishing from smaller ports rather than the traditional 3 of Ardglass, Kilkeel and Portavogie, making inshore fisheries economically important to a wider number of communities as a source of employment.

Within the inshore, few fishermen specialise in a particular species, with most being able to diversify to follow market demand. In Northern Ireland, whilst there are fisheries for a wide range of species including whelks, Palaemon and pot caught Nephrops, the value of the main species targeted by the inshore fleet is shown in figure 2. In total, the value of inshore fisheries in 2011 (excluding aquaculture and intertidal harvesting) was worth an estimated £4.8 million

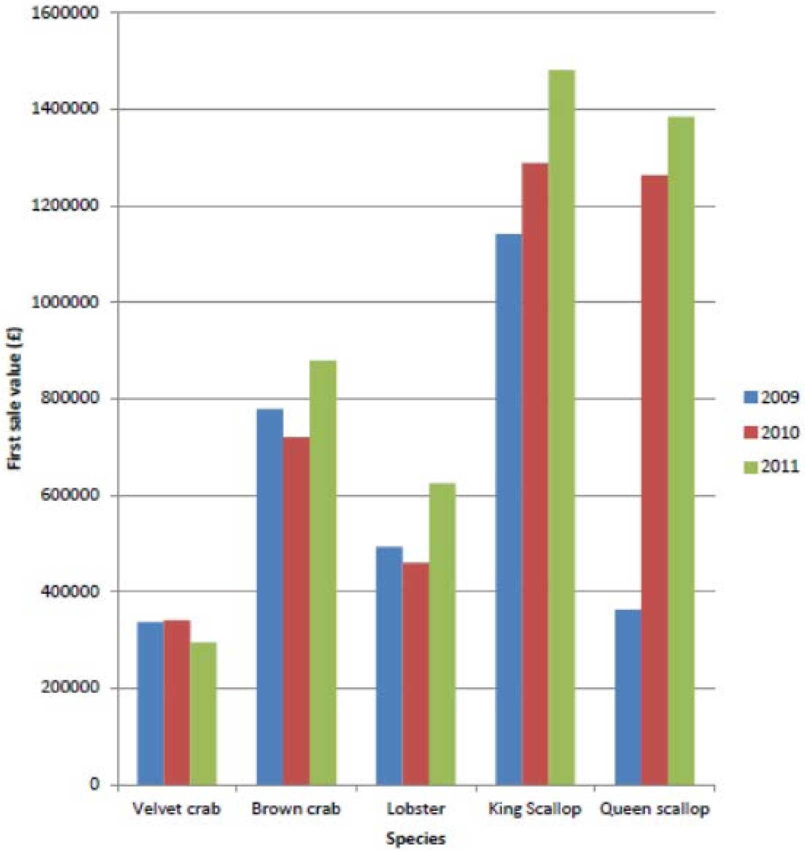


Figure 13.2 Inshore Catches

The main mobile gear fishery in the area is for the Scallop fishery (King and Queen) which occurs around the coastline of Northern Ireland during November and December

13.4 Mariculture

13.4.1 Fish

There are three charted fish farms in Northern Ireland located to the south of the site, a fixed net salmon fishery south of Torr Head and cages off Cushendun and Glenarm Bay.

13.5 Potential Effects

13.5.1 Commercial Fishing - Installation

The potential effects of the installation on fish species are outlined in section 10.3 and clearly effects on fish species will also potentially have an impact on commercial fishing. Beyond the species effects the key effects identified relating to commercial fisheries during installation is the direct disturbance and potential exclusion from traditional fishing grounds which may be more pronounced during installation than during operation.

13.5.2 Commercial Fishing – Operation

Potential operational effects on fish species are outlined in section 10.3 and clearly any operational effects on fish species such as collision or avoidance will also potentially have an impact on commercial fishing.

In respect of commercial fishing activity within a tidal farm area there are two specific areas of potential impacts i.e. those associated with the cables and the devices themselves.

Snagging a cable represents a safety hazard for the fishing vessel and damaging a cable is an offence under the United Nations Law of the Sea. Therefore it is reasonable to assume that the area in which the cables are installed will not be attractive for mobile, invasive fishing methods (i.e. beam trawls, bottom otter trawls and seining) once the cable has been installed.

Fishing with pots within the tidal energy farm might be possible provided a sufficient buffer is given to each device; however, any type of net fishing in the vicinity of the tidal devices is potentially hazardous both to the device and to the fishing vessel. The torque developed by these devices is significant and snagging a rotor could result in loss of gear or if the gear cannot be cut free loss of the vessel. What, if any, fishing might safely take place within a tidal farm is a question which requires further discussion and consultation.

For the purposes of the EIA it is assumed that all fishing vessels but particularly those operating trawl and seine nets will be displaced from the entire area. This will be reviewed as the consultation proceeds.

13.5.3 Commercial Fishing – Decommissioning

The same potential effects are considered to occur as per installation.

13.5.4 Mariculture

Given the distances from the proposed development to mariculture sites, there are not considered to be any potential effects.

13.6 Scope and Methodology – Commercial Fisheries and Mariculture

The interactions between the proposed development and the commercial fishing industry will be examined for the purpose of:

- Identifying the economic importance of species caught in the vicinity of the proposed development;
- Identifying the types and nationalities of fishing vessels likely to be affected;
- Assessing the operational characteristics of fishing vessels;
- Examining the commercial exploitation patterns of these vessels; and
- Assessing the potential economic disruption/benefits in loss/gain in income.

Continued consultation with DARD, AFBI, the North Coast Lobstermans association and other local fishing representatives will be undertaken. Analysis of catch data will be assessed in order to establish a comprehensive overview of fishing patterns and species in the area concerned.

Discussion with the local fishermen will also be undertaken to gain a better understanding of the local fishing grounds and record their views on the development of the fish stock in the area during construction and operation.

On the basis of a good understanding of fishing patterns and species present in the area, and on a dialogue with local fishing industry representatives and DARD, further steps will be taken to come to an understanding on future co-existence between fishermen and the proposed development.

14.0 Marine and Coastal Historic Environment

14.1 Introduction

The historic environment in the vicinity of the site can be broken down into two sections: The marine environment including archaeological remains, wrecks and submerged archaeological landscapes (tidal farm and subsea cable); and The coastal environment including archaeologically designated areas, scheduled ancient monuments (SAM), listed buildings and archaeological remains.

14.2 Current Knowledge

14.2.1 Marine Environment

14.2.1.1 Shipwrecks

The Northern Ireland Maritime Sites and Monuments Record (MSMR) from the Northern Ireland Environment Agency (NIEA) records at least 2600 vessels having stranded, sunk or wrecked off the coast of Northern Ireland over the last four centuries (Plets et al., 2011). A significant number of wrecks are listed for the North Antrim and Rathlin Island coastlines (Figure 14.1). However, only one of these sites, *La Girona* which was part of the Spanish Armada and lost in 1558 off Lacanda Point, has been identified as sites designated as military remains, ancient monuments or protected wrecks in the UK. Although none of the wreck sites recorded in the MSMR lie directly within the proposed development area, three wreck sites are proximal to the site (Figure 14.1): *Santa Maria (1918), Margaret Allen (1884) and St Tammany (1799)*. The red symbols identify the terrestrial sites and the white symbols identify the shipwrecks recorded in the study area. The red polygon represents the proposed development and the blue polygon is a 4km buffer.

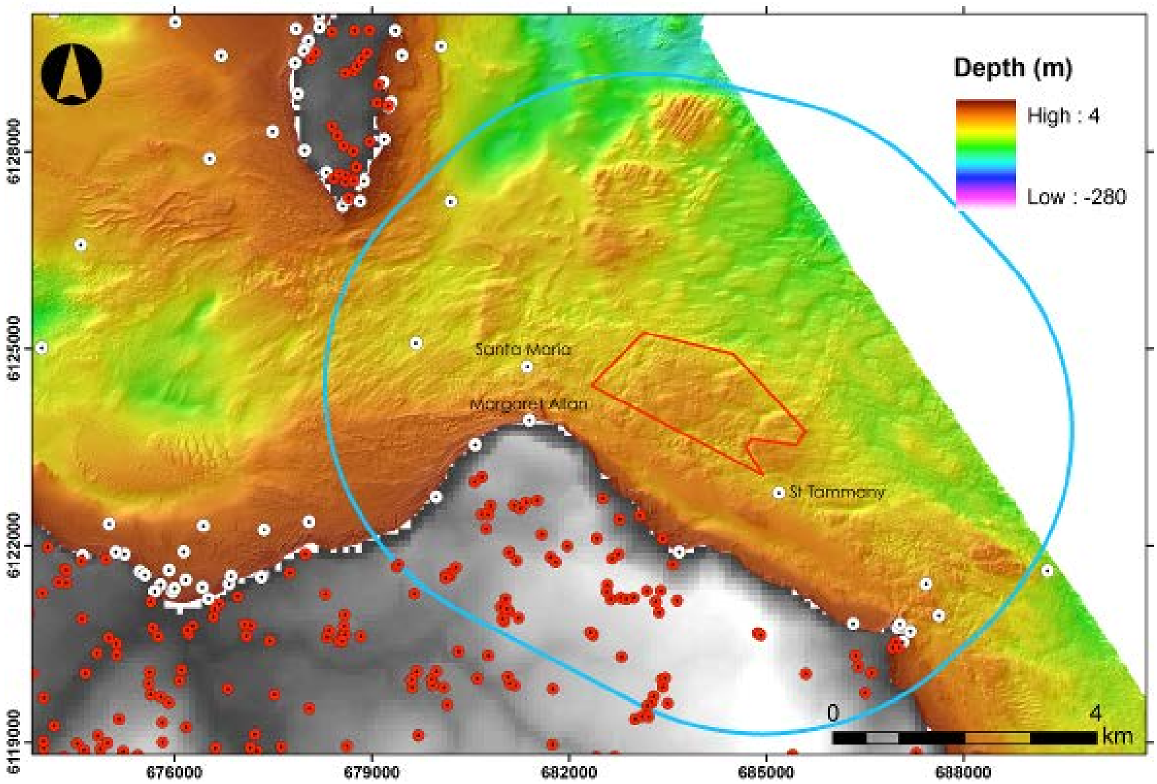


Figure 14.1: Sites & Monuments Record Entries - Study Area from NIEA Database.

14.2.1.2 Submerged archaeological landscapes

Since the last glacial period, large vertical changes in the height of sea level relative to the land surface have led to significant horizontal shifts in the position of coastlines around Northwest Europe (Brooks et al, 2012). Therefore, for much of the last 20,000 years, extensive tracts of the present-day shelf seafloor were sub-aerially exposed, primarily due to the glacial eustatic lowering of sea level. These areas represented important landscapes for prehistoric humans as they offered access to coastal and marine resources and transportation and migration routes along the coast and into the interior. A recent study by Westley et al. (2011) highlights the Ballycastle and Church Bay areas as having high archaeological potential in the context of submerged landscapes (Figure 14.2).

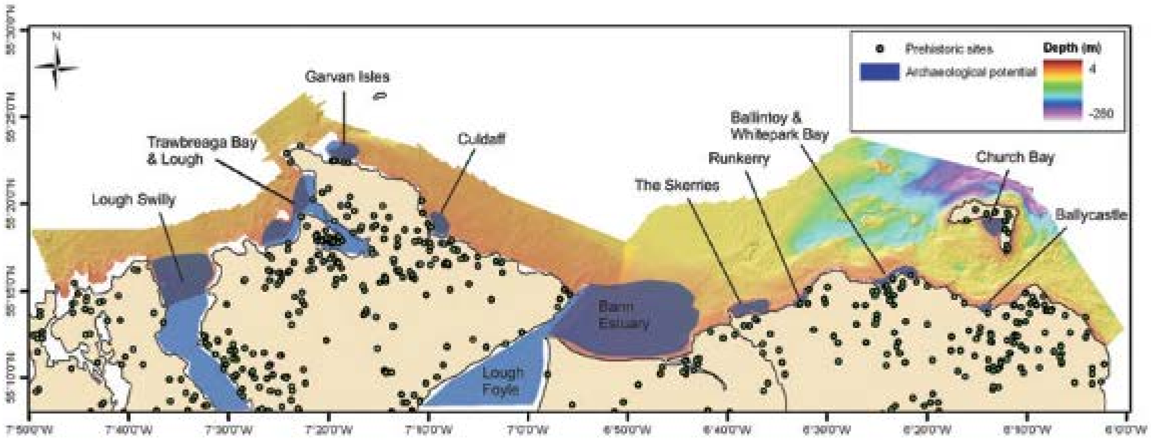


Figure 14.2: Overview map showing areas identified as having high potential for the preservation of submerged archaeological landscapes

14.2.2 Coastal Environment

There is no current information on the coastal historic environment for the potential cable landfall as the sites have not yet been identified.

14.3 Potential Effects

14.3.1 Marine Environment

14.3.1.1 Installation – Tidal Devices and Subsea Cable

During installation of devices and cables, submarine historic sites, wrecks and remains in the vicinity of installation operations could be impacted in the following ways:

Major Operations (piling, dredging, placing structures on seabed) - There is a potential for significant impact causing destruction of sites and artefacts, both surface and buried.

Displacement/dumping of Waste Material - While most dumped material is unlikely to cause damage to any but the most fragile artefacts, there is a risk of damage when large fragments are displaced. Displaced sedimentary material might bury a site delaying or preventing discovery.

Cable Laying Operations (trenching) - There is a potential for impact, causing damage to sites and destroying artefacts, along the line of trenches.

Exploratory operations (coring) - There is possibility of damaging artefacts. Cores should be inspected for presence of archaeological material.

14.3.1.2 Operation

There are no potential effects predicted during operation.

14.3.1.3 Decommissioning

Cables will not normally be removed as part of the decommissioning process. The same ground will be disturbed for removal of devices so no potential impacts are predicted.

14.3.2 Coastal Environment

14.3.2.1 Installation – Cable Trench to High Water Mark

Construction work involving ground breaking has the potential to damage or destroy sites of cultural heritage interest, both known and unknown. In addition, sites, in particular those with upstanding elements are vulnerable to accidental damage by uncontrolled activities, such as the movement of plant.

14.3.2.2 Operation

Once constructed, there is no risk of potential impact from a visual perspective from scheduled ancient monuments (SAM) and designed gardens and landscapes as cables will be underground.

14.3.2.3 Decommissioning

Underground cables will not be removed as part of the decommissioning process so no potential effects are predicted.

14.4 Scope and Methodology – Marine and Coastal Historic Environment

14.4.1 Marine Environment

The exact location of wrecks within the search area and along the subsea cable route will be identified and mapped during the EIA. The following sources, as a minimum, will be consulted to determine the presence of wreck sites and other submarine archaeological material:

- Northern Ireland Wrecks Database;
- Seazone wrecks Database; and
- The Receiver of Wrecks (Maritime and Coastguard Agency).

The geophysical surveys (multi-beam echo-sounder, side-scan sonar, magnetometer and seismics) will be discussed with an appropriate qualified archaeologist prior to the EIA data acquisition phase and the results will be archaeologically assessed.

The environmental assessment will identify direct and indirect potential impacts in terms of the sensitivity of the location, predicted magnitude of the impact and potential significance on the feature.

14.4.2 Coastal Environment

A desk based study will be conducted along potential landfalls to identify potential cultural heritage impacts and an optimum route. The following sources, as a minimum, will be consulted to determine the presence of cultural heritage features:

- The Northern Ireland Sites and Monuments Record (NIEA 2009); and
- Environment and Heritage Service. 2007. Historic Monuments of Northern Ireland, Scheduled Historic Monuments: part 1, and Monuments in State Care: part 2.

A walk over survey will be conducted by an experienced archaeologist to ground truth known features and to survey for potential unknown features.

The assessment will identify direct and indirect potential impacts in terms of the sensitivity of the location, predicted magnitude of the impact and potential significance on the feature.

15.0 Cables and Pipelines

15.1 Introduction

Cable and pipeline routes to and from Northern Ireland will require to be mapped to ensure that there is no conflict when defining the tidal energy infrastructure layouts.

15.2 Current Knowledge

In order to identify the location of cables and pipelines in the vicinity of the site the following data sources have been used:

15.2.1 Kingfisher Cable Awareness Charts (KISCA).

These charts show the locations of, and give the co-ordinates for, a number of national and international cable systems. Cable owners subscribe to KISCA to include details of their cables on these charts. The aim of this initiative is to reduce the risk of fishing vessel/cable interactions that can cause damage to the cable system and present a health and safety risk to fishing vessels.

15.2.2 UK Digital Energy Atlas Library (UKDEAL)

Data is recorded that gives the location of oil and gas installations around the UK including pipelines.

15.2.3 SeaZone Digital UK Hydrographic Office Digital Charted Data.

This gives the locations of cables shown on Admiralty Charts. This data does not indicate the status (i.e. whether it is active or out of use) of the cables.

For the purpose of this assessment it will be assumed that those cables identified are still located in their reported positions on the seabed and are active.

There are submarine telecommunications and electricity interconnectors as well as a number of pipelines in the area. However, as shown in Figure 15.1 below, as extracted from the NI SEA there are no conflicts within or adjacent to the site. In addition, there are no conflicts with respect to a potential export cable corridor to landfall.

15.3 Potential Effects

15.3.1 Installation

The major effect that could be caused to an existing cable or pipe would be direct damage during installation of device arrays and/or array and export cables.

15.3.2 Operation

There is the potential that the presence of devices in waters close to existing cables or pipes could restrict access to them for maintenance purposes.

15.3.3 Decommissioning

Decommissioning activities could have similar impact as during the construction Phase.

15.4 Scope and Methods Proposal

Desk based studies will be undertaken to collate data on existing and proposed cable and pipeline routes. Routes of all cables and pipelines within a 5km distance of the proposed array site will be confirmed with their owners. Potential new cables or pipelines in the same area will be researched. The impacts of cables from other potential arrays in the area will also be assessed.

The zone of within which cables and pipelines could be adversely affected by development has been determined as being a 500m zone either side of the centreline of the infrastructure.

The Crown Estate will undertake a conflict check with existing seabed licence holders to identify potential conflicts with other users.

Based on the collated information an assessment will be made of the potential for any significant impact on existing or likely cables and pipelines in the area. A 500m avoidance zone will be employed when selecting sites for marine renewable energy developments (in accordance with International Cable Protection Committee (ICPC) guidelines) if any proposed cables or pipes are found to transverse the proposed array site. Crossing agreements, if required, would be agreed with any future infrastructure in or close to the proposed array site.

16.0 Military Exercise Area

16.1 Introduction

The assessment of military activities in the study area is informed by the distribution and classification of Practice and Exercise Areas (PEXA). The PEXA information is produced by the UK Hydrographic Office and shows areas around the UK which are in use or available for use by the Ministry of Defence (MoD) for practice and exercises – which may be with or without the use of live ammunition.

16.2 Current Knowledge

Much of the North Channel lies within a military exercise area including the proposed site. Figure 16.1 indicates Military Practice and Exercise Areas which are mainly utilised by the Navy for submarine, general surface fleet and aircraft exercises. There is no ammunitions firing, weapons training or air force training in the vicinity of the site.

For obvious reasons military information is often sensitive and therefore published datasets are general in nature. This means that it will always be necessary to consult with the MoD or more appropriately the Defence Infrastructure Organisation (DIO) which was formed on 1 April 2011, replacing the former Defence Estates and bringing together property and infrastructure functions from across the Ministry of Defence. Consultation will include discussion about any precise deployment locations and consider how the installation, operation and decommissioning of the development may be affected by military activities.

16.3 Potential Effects

16.3.1 Installation

Temporary disruption to military exercises and activities during installation of devices and subsea cable connections may occur as there will be safety areas around activities which may cause military vessels to have to modify their routes and activities around the installation area.

It is also possible that other activities such as firing practice could be disrupted although it is noted that the Antrim Coast is not one of the sites indicated as a Danger Area for live firing or bombing.

16.3.2 Operation

It is not expected that cables from the array to the shore will have any noticeable long term effect on military activities. However, if a device array is located close to or within a practice or exercise area this could potentially have a long term effect on military activities.

Also the potential impact of noise emitted from the turbines affecting submarine acoustic sensors used in navigation and detection will be assessed.

16.3.3 Decommissioning

As per section 16.3.1 except that subsea cables will be left in situ following decommissioning.

16.4 Scope of Work – Military Exercise Area

DPME will consult closely with the DIO to enable military activities in the development area to be assessed as part of the EIA process.

17.0 Disposal Sites

17.1 Introduction

The deposit of substances or articles in the sea or under the sea-bed within Northern Ireland territorial waters or controlled waters is regulated by the DOE MD, under the Marine and Coastal Access Act 2009 The main purposes of the Act are the protection of the marine environment, the living resources that it supports and human health; and to prevent interference with other legitimate sea users.

17.2 Current Knowledge

Based on information provided from Centre for Environment, Fisheries and Aquaculture Science (CEFAS) to inform the NI SEA, there are two open disposal sites to the West of the site. In addition, the deep water trough between Northern Ireland and south-west Scotland (Beaufort's Dyke) was used as a dumping ground for military munitions between World War II and the 1970's. During this period approximately 1,000,000 tonnes all types of munitions, including 14,500 tonnes of phosgene artillery shells and possibly fuses and detonators, were deposited. While the dumping site itself is well outside the proposed array area there is a potential risk of material migrating from the site. Disturbance could result in significant adverse effects. Disposal sites are shown in Figure 17.1.

In addition, throughout the area there is a risk of encountering munitions associated with wartime wrecks, both of military and merchant vessels and of military aircraft (Scottish Executive 2007). In general, the risk of munitions contamination is somewhat less in the vicinity of wrecks than for dump sites, since the munitions still tend to be enclosed and immobile within the wrecks; however, munitions may have been thrown clear of the vessel as it sank, or may become exposed as the wrecks gradually break up. There is also a risk of the presence of unexploded mines. It should be assumed that the North Channel and adjacent waters are potentially at risk from un-swept mines left over from the two world wars (Martin and Smith 2007).

17.3 Potential Effects

17.3.1 Installation – Subsea Cable

Direct disturbance of previously disposed material where the tidal turbines, array and subsea export cable(s) are located.

17.3.2 Operation

The only potential impact considered during operation is the exclusion to disposal that the tidal farm and subsea cable will create.

17.3.3 Decommissioning

The only potential impact considered during decommissioning is the exclusion to disposal that the subsea cable will create.

17.4 Scope and Methodology – Disposal Sites

A review of historic maps and charts for the area will be carried out to determine if any historic dumping was carried out in the area. As the proposed array location is at a much shallower depth than the Beaufort's Dyke migration of munitions are deemed unlikely. This assumption is supported by most of the items washed up being south of Beaufort's Dyke.

In addition, a review of the geophysical data across the site will be undertaken to identify if there are any potential munitions shown up either on echo sound, side scan or Magnetometry.

If munitions are encountered Crown Estates 2010 (Dealing with munitions in marine aggregates) will be followed.

18.0 Commercial Shipping and Navigation

18.1 Introduction

This chapter provides information on current commercial shipping movements in and around the proposed development and considers the sensitivity and the potential significance of effects on shipping and navigation. Movements of recreational vessels are considered within Chapter 19 Recreation, Tourism Socioeconomic.

18.2 Current Knowledge

Recognising that there is considerable scope for interaction between tidal energy farms and all forms of shipping, a shipping density study was commissioned to inform the NI SEA (Appendix D – Anatec Navigation Report, Nov 2009). The conclusion is summarised in Figure 9.4.3 of the NI SEA (shown below in Figure 18.1), showing where the type of vessel and density of movement are clearly identified.

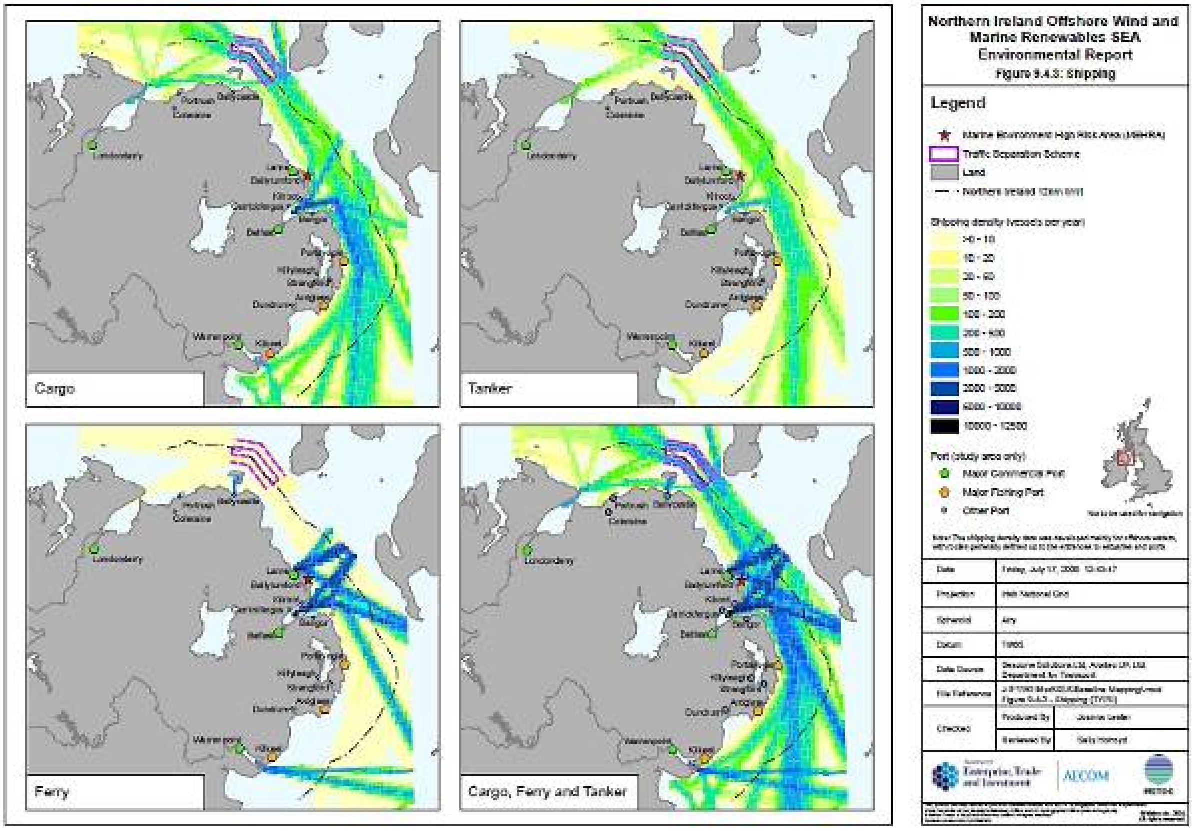


Figure 18.1 Shipping Densities – Results from Anatec Navigation Report

Details of shipping movements in and adjacent to the proposed site are incomplete. The above figure indicates approximately 20 to 50 ship movements adjacent to the potential site. The routes taken by ships between ports were obtained from several data sources, including radar and AIS (Automatic Identification System) surveys, satellite tracking individual ship passage plans and Admiralty Sailing Directions. The main limitation of this dataset being that it only covers merchant ships (vessels above approximately 100 gross registered tonnes) and excludes vessel activity which is termed as non-routine, i.e. ships not sailing economically between ports but taking part in special operations. This includes military, fishing and recreational vessels, as well as vessels at anchor or moored.

As defined in Notice to Mariners No 17, The North Channel Traffic Separation Scheme (TSS), under the authority of the International Maritime Organisation (IMO) lies within the vicinity of the site. The North Channel is a 'recognised sea lane essential to international navigation' and connects the Irish Sea to the Atlantic Ocean enabling commercial, recreational and fishing vessels to navigate the stretch of water between the Irish and Scottish main land.

The Rathlin Island Ferry operated by Rathlin Island Ferry Ltd provides nine daily crossings between Rathlin Island and Ballycastle on the mainland.

There are no Marine Environmental High Risk Areas within or adjacent to the site.

The main port in County Antrim is at Ballycastle lying immediately to the west of the site. In addition to the ferry terminal to Rathlin Island, the marina has 74 berths for recreational sailing and charter vessels for sea fishing.

The Royal National Lifeboat Institution (RNLI) lifeboats are stationed at Red Bay, Cushendall (15km south of the site) and at Portrush (30km west of the site).

18.3 Potential Effects

Effects on shipping and navigation can be categorised as effects on safety, and effects on issues related to economics such as journey times and distances, and trade. In terms of safety it is important to note that there are various rules, regulations and guidelines that relate to safety of navigation with regards to any offshore development that are in place to help prevent casualties and collisions.

18.3.1 Installation

18.3.1.1 Increased Journey Times and Distances

During installation there will be exclusion or avoidance zones in operation around activities for the purposes of safety. The introduction of installation vessels and equipment into the study area will require vessels to move around the construction activities potentially increasing journey times and distances.

18.3.1.2 Displacement of Shipping Density

The safety zones that will be in place during construction activities may affect shipping density although this will have the most significant effect in constrained waters.

18.3.1.3 Reduced Trade Opportunities

Temporary reduced access to ports and harbours may occur during construction activities in some island locations and this has the potential to have an adverse effect on trade and supplies.

18.3.1.4 Reduced Visibility

The presence of installation vessels, barges, jack-up rigs and other construction equipment has the potential to obstruct the view of other vessels, navigation features such as lights and buoys and the coastline. This could cause a hazard to shipping in areas where visibility is particularly important for navigation or areas where the topography already constrains visibility.

18.3.1.5 Collision

The presence of slow moving or stationary installation vessels and equipment is likely to affect the probability of close quarter encounters and collisions with both vessels moving under power and drifting vessels. The presence of construction activities also has the potential to cause small and recreational vessels to modify their routes to use areas transited by larger vessels, which potentially increases the risk of encounter or collision. In the event of a collision occurring there is a risk of extensive and serious environmental impacts associated with the spillage of oil and hazardous cargo's.

18.3.1.6 Search and Rescue

Search and rescue exercises and operations may take place throughout the study area. The planning of such activities would need to be adapted to take into account the presence of installation equipment. In addition, the installation of marine renewable energy devices could impact on the use of radar for navigation due to the presence of construction equipment above the sea surface.

18.3.2 Operation and Maintenance

The effects of the operation of marine renewable energy devices upon shipping and navigation will be similar to those experienced during the installation

18.3.3 Decommissioning

The effects of decommissioning the tidal development upon shipping and navigation will be similar to those experienced during the installation.

18.4 Scope and Methodology – Shipping and Navigation

The potential for these effects to be reduced will depend entirely upon the siting of a device in relation to shipping routes and the type of device selected i.e. submerged or protruding. The scale of potential effect on navigation will be assessed as part of the EIA and the Navigational Safety Risk Assessment (NSRA). A qualified and experienced assessor of navigational risk will be employed initially to define a preliminary hazard analysis (PHA) proposal which will detail the scope and methods by which it is proposed to undertake the NSRA for consultation with the Maritime and Coastguard Agency MCA and other relevant stakeholders. Then to carry out the NSRA in accordance with DTI (2005) 'Assessment of the Impact of Offshore Wind Farms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms' and the MCA Marine Guidance Note (MGN) 371 'Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues'.

The assessment will include:

- Acquisition of both AIS and Radar data to ensure coverage of all vessels types in the area;

- Consultation with local fisheries, yacht clubs and tourism agencies etc. to Identify non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, commercial passenger vessels undertaking visits to the OREI, racing, aggregate dredging, etc; and

- A full NSRA of the likely impact of the development on navigation, taking into consideration MGN 371 (MCA 2008), MGN 372 (MCA 2008b) and the DTI Guidance Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms (DTI 2005) (also considered relevant for other renewable devices).

Mitigation measures could include:

- Notice to Mariners providing coordinates of the tidal energy array;
- Delineation of the tidal energy array using cardinal Marker Buoys;
- Fog warning system on marker buoys;
- All vessels and devices will be lit and marked in accordance with regulations and MCA and Trinity House guidance; and
- Maintain good communications with the relevant ports/ local users and the issue of appropriate notifications during installation, maintenance, and decommissioning.

19.0 Recreation, Tourism & Socio-Economics

19.1 Introduction

The EIA will consider the socio-economic context of the proposed development upon the local economy and Northern Ireland as a whole. Potential impacts from the proposed development on human beings, focussing on issues such as existing economic activity, land and sea use, tourism, amenity and health and safety will be examined.

19.2 Current Knowledge

19.2.1 Moyle District – General Statistics

Covering an area of around 480km^2 and with a population of approximately 16500, the district is largely rural with a low population density (0.34 persons/hectare compared to 1.22 persons/hectare for the rest of Northern Ireland). Around 5500 people are employed making up around 1% of the Northern Ireland total.

Rathlin Island is the only inhabited offshore island in Northern Ireland, with a rising population of now just over 100 people, and is the most northerly inhabited island off the Irish coast. The L-shaped island is 6 km from east to west, and 4 km from north to south. Rathlin is part of the Moyle District Council area, and is represented by the Rathlin Development & Community Association.

19.2.2 The Existing Environment

The key elements, which might be used to describe the socio-economic environment, are linked primarily to employment and land use but also to the cultural history of the area and the people. The following summary information is defined:

- Retail and Wholesale – 17%;
- Health – 16%;
- Education – 16%;
- Hotel Trade – 15%;

A review of tourism in relation to Northern Ireland's economy undertaken, on behalf of Northern Ireland Tourist Board and DETI (CogentSI 2008) identified that 5.2% of jobs in Northern Ireland are directly supported by tourism which supports £1,782 million sales by Northern Ireland producers.

Marine and coastal activities include sailing and boating, scuba diving, sea angling, walking, canoeing, surfing, bird watching, and visiting coastal attractions such as castles and archaeological features.

North Antrim`s coastline and Rathlin Island play an influential role in attracting tourists and recreational users to the country through the provision of stunning scenery, wildlife, cultural assets and a wide range of organisations providing a variety of sports and activities. Some of these activities are listed as follows:

- Tourist Attractions and Sightseeing – Giants Causeway, Dunluce Castle Ruins and the Carrick-a-rede Rope Bridge;

- Walking – Antrim Hills Way (35km) through Antrim Coast and Glens AONB;
- Wildlife watching – Birds and mammals;
- Sailing – General and race sailing;
- Water sports - Suba diving and surfing;
- Recreational Beaches – Five bathing water beaches; and
- Sea Angling – Charter boats.

19.3 Potential Effects

The marine environment, landscape and resources play an important role in many tourism and recreation activities. Therefore, any impact on the coastal or marine environment through the installation, operation or maintenance of tidal turbines, inter-array and export cables, landfall and onshore infrastructure could potentially have an effect on the tourism industry, recreation and the socio-economic balance of the area.

19.3.1 Installation

19.3.1.1 Noise

Noise generated during the installation of the marine devices will potentially have direct and indirect effects on recreation and tourism, although the effects will only be short term. The main sources of construction noise could include:

- Vessels;
- Drilling;
- Movement of machinery/device components;
- Installation of machinery/device components; and
- Cable trenching.

The main direct effects of installation noise is related to general disturbance that will be experienced by visitors to key coastal attractions/locations e.g. beaches and coastal paths, and participants in key coastal and marine recreational activities e.g. sailing, swimming and water sports. Installation noise may have adverse effects on the breeding, feeding and migratory patterns of marine wildlife and seabirds, leading to their displacement or avoidance of areas. This could potentially have an indirect effect on the marine wildlife watching industry and bird watchers.

19.3.1.2 Transportation

There will be a requirement, as part of the installation process, for the transportation of the various components of the marine devices. This will include the movement of device components from the point of production to a port or coastal location for transfer onto deployment vessels. The main effects associated with the transportation of large pieces of machinery include congestion caused by large, slow moving vehicles, increased noise, vibration, air pollution and general environmental disturbance. Due to the predicted size of the marine devices, most will require deployment from harbours that can accommodate vessels with sufficient loading capacity for device deployment. In most cases, access routes to these harbours have been designed to accommodate the movement of large vehicles. There is also potential that the marine vessels could disrupt sailing routes, fishing activities and other water sports.

19.3.1.3 Landscape, Seascape and Visual Amenity

The effects on landscape, seascape and visual amenity are discussed in Chapter 22 The landscape, seascape and views around the coastline are intrinsic to the area's ability to attract tourists and visitors. Installation activities (including onshore connections) may temporarily affect the general attractiveness of certain areas which could potentially affect visitor's perceptions and enjoyment of an area.

19.3.1.4 Access Restrictions

In the interests of efficiency and safety, installation activities may involve some restriction of public access to areas where construction is underway. Depending on location, this may affect sailing activities, sea angling, diving, open water swimming, water sports and wildlife watching.

19.3.1.5 Water Quality

In terms of the installation of devices there are a number of potential sources of water pollution including:

- Release of contaminated materials during piling, drilling or grouting;
- Fuel spillage; and
- Leakage of device lubricants, Antifoulants and hydraulic oils.

Any water pollution arising from the installation of devices could potentially affect bathing water quality and local beaches.

19.3.2 Operation

19.3.2.1 Noise

As with installation noise, operational noise may have an adverse effect on the breeding, feeding and migratory patterns of marine wildlife and seabirds, leading to their displacement or avoidance of areas. This will potentially have an indirect effect on the marine wildlife watching industry and bird watchers.

19.3.2.2 Landscape, Seascape and Visual Amenity

The effects on landscape, seascape and visual amenity are discussed in Chapter 22. The landscape, seascape and views around the coastline are intrinsic to the area's ability to attract tourists and visitors. The presence of marine devices in certain locations may affect the people's perceptions and enjoyment of an area.

19.3.2.3 Safety and Collision Risk

The effect of marine devices in terms of safety and collision risk is discussed in Chapter 18 in relation to shipping and navigation, Chapter 12 with respect to marine mammals and Chapter 11 in relation to Birds. Submerged, partially submerged and sub-aerial devices all present a potential hazard to other users of the marine environment as collisions could cause damage to vessels and danger to the health and safety of people in the area. Increased risk of collision with structures at sea could act as a deterrent to recreational sailors or water sports enthusiasts.

19.3.2.4 Access Restrictions

In order to avoid potential collisions, areas in which devices are located may require access restrictions to be imposed. Such restrictions may have a negative effect should they prevent access to specific sites or areas of coastline which are of special interest. The Royal Yachting Association (RYA) has identified a number of potential effects associated with renewable energy projects including loss of cruising routes, being ‘squeezed’ into commercial navigation routes and effects on sailing and racing areas (RYA 2012) Informal activities such as kayaking may also be affected in similar ways.

19.3.2.5 Disturbance to Wildlife

As mentioned previously in terms of noise and vibration, the operation of marine devices may lead to the disturbance and potential displacement of marine wildlife or seabird. Other factors potentially affecting marine mammals and birds include: habitat loss; disturbance, disruption or loss of food sources and feeding areas; physical severance or obstruction of migratory routes; population pressures if certain species are forced into smaller areas or predator habitats. The displacement of marine wildlife or birds could have negative effects on marine wildlife watching operators and bird watchers. The effects of marine devices on marine mammals and birds are discussed in their respective chapters.

19.3.2.6 Energy Extraction and Effects on Coastal Areas and Beaches

The potential implication of energy extraction on recreation and tourism are associated with how energy extraction affects coastal processes and how these effect local beaches. The effects of energy extraction are discussed in Chapter 14: Marine and Coastal Processes with regard to marine processes.

19.3.2.7 Creation of Tourist Attractions

There is potential that the marine devices themselves could have positive effect on recreation and tourism by becoming key tourist attractions. With increased awareness of climate change and the opportunities for gaining first-hand experience of the evolution of new technologies, the attraction of marine devices which are accessible (and visible) could be potentially high in the short-term. Interest is likely to decrease as wave and tidal power become more commonplace.

19.3.3 Decommissioning

The effects of decommissioning the tidal development on the socio-economic environment are very similar to the installation effects.

19.4 Scope and Methodology – Socio-Economic

A detailed assessment will be undertaken focussing on North Antrim economic status with desk based studies and interviews with key industries, organisations and individuals in the region. A tourism assessment will also be undertaken to provide a baseline and analysis of potential impacts associated with the proposed development.

Consultation will take place with key consultees including:

- Moyle District Council;
- Northern Ireland Tourist Board;
- The Royal Yachting Association;
- Local Development and Community Association; and
- Other parties associated with recreation and tourism.

20.0 Noise and Vibration

20.1 Introduction

The generation of noise or vibration is not in itself a topic in which an EIA can be undertaken. However, the effects of noise can be experienced by a range of receptors including mammals and fish.

A noise assessment will be undertaken to predict the likely noise sources and emissions throughout the phases of the project to enable specific EIA to be carried out for specific receptors in their respective Chapters.

This chapter describes how the baseline noise characteristics of the site will be measured and how a prediction of the installation and operational noise of the Project will be undertaken.

20.2 Current Knowledge

There is little or no information available on the current noise levels on the site. However, baseline noise and vibration levels are likely to be low within the study area, particularly from anthropogenic sources, as there is relatively few industrial developments, low population density and low traffic levels in the area which is more likely to be frequented by smaller fishing and recreational vessels, with more significant volumes of larger traffic using the deeper offshore areas in the north east of the study area within the TSS.

Noise from tidal stream turbines that is in the audible range of marine species is associated with vibrations are produced by the drive train components such as the gearbox and generator. These vibrations travel through the drive train to the rotor, nacelle walls and support structure where it interacts with the surrounding water and is released as noise. Operational vibration and noise is generated on a cyclic nature during each flood and ebb tide, with hydrodynamic noise generated from the rotating blades, the support structure and mechanical noise from the rotating machinery (i.e. hub bearings, gearbox and generator). With the exception of periods of slack water and when operation and maintenance activities are being undertaken this will be generated throughout the lifetime of the project.

There is limited information on the actual noise generated during installation, operation and decommissioning due to the number of tidal energy installations being limited to Strangford Lough and European Marine Energy Centre (EMEC) in Orkney.

20.3 Potential Effects

20.3.1 Installation

Noise disturbance from installation activities such as drilling as well as increased vessel traffic may cause disturbance to the surrounding community.

Subsea construction noise data indicate that the levels of noise produced during construction of the SeaGen device in Strangford Lough are considerably lower than those that may cause fatality, physical injury or audiological injury to species of fish and marine mammal. The data also indicated that species of fish and marine mammal are unlikely to have been disturbed unless they were in close proximity to the drilling operation

20.3.2 Operation

The dominant operational noise propagation will be from the rotating equipment through its blade interaction with the sea. Additional mechanical and electrical noise sources are likely to be transmitted to the sea via direct coupling and from the interaction of the device structure with tidal currents. Additional noise will be propagated from service vessels during operation and maintenance activities.

20.3.3 Decommissioning

The noise effects of decommissioning the tidal development upon the environment are very similar to the installation effects except that piling or drilling which have been identified as major sources or noise, will not be required.

20.4 Scope and Methodology

To determine the acoustic footprint of operational tidal turbines at the site, an understanding of the ambient background sound is required. This will provide the floor upon which turbine audibility for receptors (particularly marine mammals) can be calculated, and enable impact assessment to be undertaken. This will further give an indication of whether animals will be able to detect operating turbines far upstream or only in close proximity (influencing assessment of and potential mitigation of collision risk). A baseline is also important for devising a monitoring plan which is likely to be required as conditions of the consent.

In order to ascertain the noise generated during the lifecycle of the project, the following work is required:

- Measure baseline ambient noise for the site;
- Measure the noise emissions for the Project (turbines, vessels, drilling etc.);
- Refine the noise signatures for the project;
- Undertake predictive modelling for the noise propagation; and
- Evaluate the effects of the additional noise with reference to the baseline measurements.

The assessment process is shown in Figure 20.1 below:

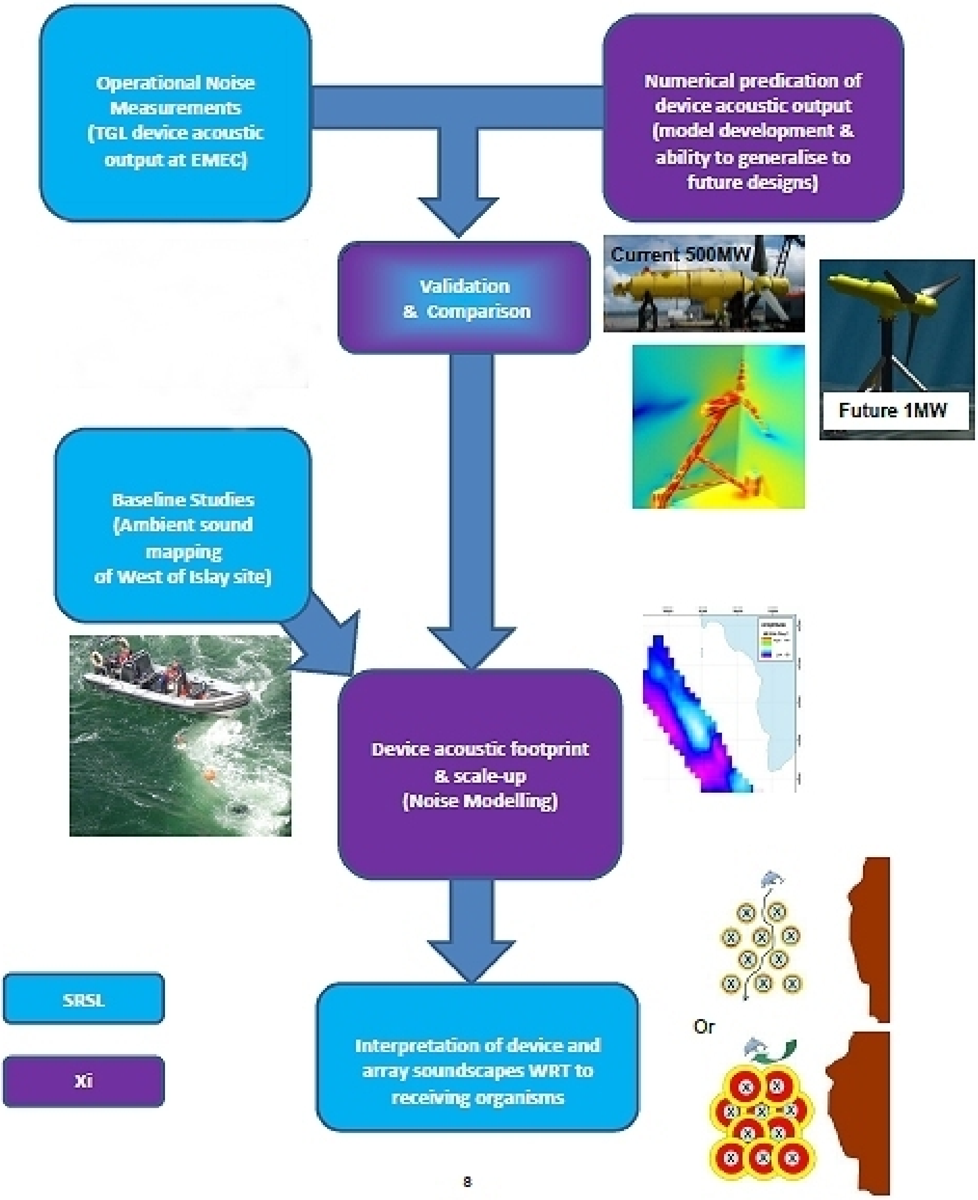


Figure 20.1: Schematic Showing Measurement and Modelling Interaction.

20.4.1 Baseline Ambient Noise

In order to predict the noise emissions directly attributable to the Project, it is first necessary to conduct acoustic measurements in the region of the proposed tidal array, so as to determine the ambient (or background) noise at the site.

To measure ambient underwater noise at the Project site one option, is to take recordings using the "Drifting Ears" approach specifically developed by SRSL for high energy tidal sites. Other suitable methods will be assessed and used if appropriate, however the customised "Drifting Ears" method was applied to other offshore marine renewable developments because traditional measurement techniques are not well suited to flowing water and typically expose the receiving hydrophone element to contaminating water-flow noise from surface friction / turbulence, cable strum or noise from the mounting platform itself. In most studies of marine acoustics, this problem is negligible but as tidal energy sites are specifically chosen because of their high flow rates, this factor is of prime consideration when monitoring ambient sound or ship acoustic output.

To do these measurements SRSL will deploy the newly upgraded SAMS Drifting Ears method, a concept which has been deployed in high-energy tidal sites such as the Falls of Warness EMEC tidal test site, Sound of Islay, Eday, the Pentland Firth and West of Islay. Sounds up to 150 kHz and down to 50 Hz will be characterised during drifts over the site. The practical deployment would take place over a week in a time and will be designed to enable recordings at near slack and full tidal flow on both ebb and flood tides, ideally from neaps into full spring tides.

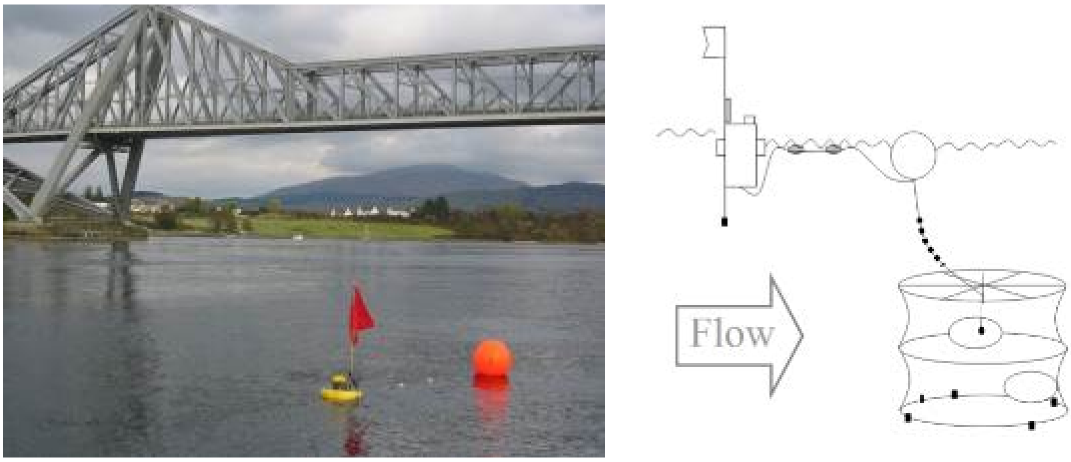


Figure 20.2: Deployment and Structure of the "Drifting Ears" Recorders Developed by SRSL.

Analysis of noise data from the drifters will be undertaken, to establish spectral and temporal trends based on sampled data from ambient noise trials taken from two drifting systems over the survey period. These results will be used to produce baseline ambient noise maps for the area of interest.

20.4.2 Noise Emissions from Project

Noise emissions from the Project will be generated by the following:

- During Installation: Vessels, drilling and component installation;
- During Operation: Operation of the turbine and visiting maintenance vessels; and
- During decommissioning: Vessels, decommissioning and removal of installations.

For the purposes of this evaluation, noise generated by decommissioning activities is assumed to be similar to that generated during installation.

20.4.3 Noise Propagation Model

Data relating to the specific devices to be deployed at FHTEP will then be input to an acoustic-structural interaction model which analyses how vibrations produced by drive trains can enter the environment as noise. The models have been used with great success both in the on-shore wind turbine and the off-shore tidal stream turbine industries to predict noise levels. The level of noise produced by a tidal stream turbine and its frequency are dependent on the power output of the turbine, the key components that make up the drive train such as the gearbox and generator, and the surface area of the turbine that is in contact with the marine environment such as blades and support structure. The noise of a single device would then be modelled to represent the full turbine array, and propagation evaluated to assess the effect of underwater topography on the acoustic propagation and masking by ambient environmental noise.

The results of the ambient noise study and data analysis, along with the operational noise modelling will be provided to relevant EIA topics i.e. mammals for noise impact assessment

21.0 Electromagnetic Field (EMF)

21.1 Introduction

Electrical and magnetic fields are both generated by the movement of electrical charge. Electrical fields (E fields) are proportional to the voltage (V) in a cable, and magnetic fields (B fields) are proportional to the current (A). The motion of an organism, or even seawater, through an existing B field causes the generation of an electrical field known as an induced electrical field (iE field) . E fields are produced around electrical cables that are not perfectly shielded. Industry-standard cables are constructed with shielding designed to retain E fields within the cabling. B fields, however, exist beyond even industry-standard cables and, as described above, are able to induce electrical fields in the surrounding environment. Therefore, although E fields generated directly by the movement of charge in the conductor will be contained within the cable, iE fields will still exist due to the effect of the B fields generated by the current in the conductor. It is important, therefore, to consider the effects of both magnetic and electrical fields on the environment surrounding the cable.

Power cables, such as those used to export electricity generated from tidal arrays, produce E- and B-fields when current passes through them. The B-field is detectable outside of the cable structure and this in turn creates a further induced E field (iE). Studies have shown that electromagnetic fields (EMF) radiate beyond the cable into both seawater and the seabed. However, the fields emitted by the cables are limited spatially and the field decays rapidly with horizontal and vertical distance from the cables (Normandeau et al., 2011).

21.2 Technical Definition

CMACS (2005) proposes the following terminology, to standardise descriptions, which is adopted in this report.

EMF should be used to describe the direct electromagnetic field. The two constituent fields of the EMF should be clearly defined as the E (Electric) field and the B (Magnetic) field, whilst the induced electric field should be labelled (iE) field. In summary the E field will be retained within industry-standard cables. The B field is detectable outside the cable and induces an iE field outside the cable.

21.3 Background Information

21.3.1 The University of Liverpool Centre for Marine and Coastal Studies (CMACS 2003) and Cranfield University.

The first report of the COWRIE EMF study in 2003 was based on offshore wind developments and made the following findings:

- There is no direct generation of an E-field outside of the cable;
- B-fields generated by the cable created induced E-fields (iE) outside of the cable, irrespective of shielding;
- B-fields are present in close proximity to the cable and the sediment type in which a cable is buried has no effect on the magnitude of B-field generated;

- The magnitude of the B-field on the 'skin' of the cable (i.e. within millimetres) is approximately 1.6 micro Tesla (μT) which will be superimposed on any other B-fields (e.g. Earth's geomagnetic field); and
- The magnitude of the B-field associated with the cable fall to background levels within 20m.

Considering the results of the modelling undertaken as part of the research, in respect of significance to electro-sensitive fish, the report found the following:

- EMF emitted by an industry standard subsea cable will induce E-fields;
- Cables will emit approximately 91μV/m at the seabed adjacent to a cable buried to 1m. This level of E-field is on the boundary of E-field emissions that are expected to attract and those that repel elasmobranchs;
- The iE-fields calculated from the B-field were also within range of detection by elasmobranchs;
- Changing the permeability or conductivity of the cable may effectively reduce the magnitude of the iE-field;
- To reduce the iE-field that is below the level of detection of elasmobranchs will require a material of very high permeability, hence any reduction in E-field emission would minimise the potential for an avoidance reaction by a fish if it encountered the field but may still result in an attraction response; and
- The relationship between the amount of cabling present, producing iE-fields and the available habitat of electro-sensitive species is an important consideration.

21.3.2 COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2 (Gill *et al 2009)*

A further study in 2009 (3), funded by COWRIE, looked at the effects of EMF on electro-sensitive fish and concluded that:

- There is evidence that benthic elasmobranch species studied did respond to the presence of EMF emitted by a subsea cable. The responses were, however, variable within a species and also during times of cable switch on and off, day and night;
- The overall spatial distribution of fish was non-random, and dogfish were more likely to be found within the zone of EMF emission during times when the cable was switched on; and
- There did not appear to be any differences in the fish response by day or night or over time.

21.3.3 Knowledge Review SNH 2010

More recently a report was commissioned by SNH (4) to investigate EMF and noise emission from marine energy developments on three species, Atlantic Salmon, European Eel and Sea trout, the main findings with respect to EMF being that:

- Atlantic salmon and European eel can use the earth's magnetic field for orientation and direction during migrations. Juvenile sea trout respond to both the earth's magnetic field and artificial magnetic fields;
- Current knowledge suggests that EMF`s from subsea cables and cabling orientation may interact with migrating eels (and possibly salmonids) if their migration or movement routes take them over the cables, particularly

in shallow waters (<20m). The effect, if any, could be a relatively trivial temporary change in swimming direction, or potentially a more serious avoidance response or delay to migration. Where this will represent a biologically significant effect cannot yet be determined;
- All three species are likely to encounter EMF from subsea cables either during adult movement phases of their life or their early life stages during migration within shallow, coastal waters adjacent to the natal rivers; and
- The review identified no clear evidence that either attraction or repulsion due to anthropogenic EMF will have an effect on any of three fish species identified in the report.

21.3.4 Effects of EMF`s from Undersea Power Cables on Elasmobranches and other Marine Species

A knowledge review was commissioned by The Department of the Interior in the US (Normandeau 2011) provided a comprehensive review of studies to date on potential effects of EMF on marine fauna. The report modelled the expected EMF's from a range of power cables and reviewed the available information on sensitive marine species. The report reached the following conclusions:

- The field is strongest directly over the cable and decreases rapidly with horizontal and vertical distance from the cable;
- The cable magnetic field is perpendicular to the direction of the cable. A water current or organism moving parallel to the cable magnetic field will not generate an induced electric field. Orientation of the cables relative to the flow of water and migration routes can reduce the potential impacts;
- Marine species are more likely to react to the magnetic fields of DC cables than AC cables. DC cables were found to have a greater impact as they can influence the intensity of the local geometric field;
- The risk of interference only exists in the areas surrounding the cables where sensory capabilities overlap with the cable EMF; and
- Magnetic fields can be minimised by placing the cables close together, allowing the field vectors to cancel each other out.

Despite the significant research, desk-based, laboratory and field studies which have been undertaken, it is still generally considered that the current state of knowledge regarding the EMF emitted from subsea power cables is too variable and inconclusive to make an informed assessment of any possible environmental impact of EMF.

Several other major wind farm developments have been planned, or indeed are under construction, in the UK. From a review of the environmental statements produced for these developments, it would appear that there is a general consensus that the electromagnetic fields likely to be present around a wind farm or tidal energy development will not have a significant environmental impact.

21.4 Potential Effects

21.4.1 Introduction

The detailed electrical design is yet to be completed and consequently the following is based on a generic electrical design. Details will be considered further in the EIA as the design process develops.

21.4.2 Installation

Although there may be electrical/magnetic fields associated with installation equipment this is not expected to be significantly different than for normal vessels.

21.4.3 Operation

Inter-Device Cables

These cables collect the power from all of the turbines and bring it to one or more "collection" points from where it is transported to shore. Cables within the tidal farm arrays will generally be at lower voltages than the main export voltage. Between 6.6 and 33kV would be typical.

Export Cables from Device Array to Shore

The array-to-shore cables transmit the power to shore. The electrical parameters of these cables depend on whether the power is transmitted directly to shore or if the power produced by the device array is transmitted to shore at a higher voltage than the collection voltage. In the latter an offshore substation is required, which acts as the collection point within the device array, from which an export cable (or cables) runs to the shore. It has been assumed that export cable voltages will be either 33kV or 132kV (i.e. as for the smaller wind farm projects).

Voltages in the inter-array and export cables are likely to range from 6.6 to 33kV at around 150V. However, because the level of B fields is proportional to the current, then the current will be at its highest in the export cable at around 300A. The standard cable is an industry-standard, three-phase 33kV, 300A, 50Hz alternating current (AC) XLPE (cross linked polyethylene) cable carrying 30MW.

In a typical industry-standard cable conducting 132kV and an AC current of 350A, the size of the B field produced would be 1.6μT CMACS, 2003 (2). This B field would be present only directly adjacent to the cable, and although it would be additive with the earth's natural geomagnetic field (approximately 50μT), it was shown that the magnitude of B field associated with the cable would fall to background levels within 20m of the cable. Furthermore, the modelling conducted by CMACS showed that the magnitude of a B field is not affected by any non-magnetic sediment in which a cable may be buried.

In the same study CMACS showed that for a cable buried 1m below the seabed the magnitude of the iE field at the seabed would be approximately 91μV/m. Although the magnitude of the B field was not affected by the fact that the cable was buried, the iE field dissipated more quickly in sediment than in seawater. At a distance of approximately 8m from the cable the iE field in the sediment was only 1 or 2μV/m, whereas in seawater the iE field at this distance was still approximately 10μV/m.

21.4.4 Decommissioning

Although there may be electrical/magnetic fields associated with decommissioning equipment this is not expected to be significantly different than for normal vessels.

21.5 Scope and Methodology - EMF

It is likely that the B and iE fields produced by the subsea electrical cables for the Project will be large enough to be detected by receptive marine organisms. In locations where the cables may be buried, marine organisms on the surface of the seabed will be exposed to lower fields than they would be where the cables are exposed. It is not possible to make any accurate predictions as to how these relatively weak B and iE fields will affect these species. Given the localised scale over which these electromagnetic fields are likely to propagate, however, it is likely that any effects which may occur would be highly localised. It is expected that the magnitude of the B field and iE field will be approaching zero at 10m and 20m, respectively, from the cables.

In order to minimise the potential impact of EMF the following actions are proposed:

Cables will be specified with adequate shielding to minimise the emission of EMF;
Three phase cables which have been shown to emit the lowest levels of EMF either individually shielded triaxial cable or with common outer shield will be used in preference to DC cable.

Where required, cables will be buried either by rock dump, rock bags or some other form of cable protection as referenced in Chapter 5: Project Description: and
Where feasible magnetic fields will be minimised by placing the cables close together, allowing the field vectors to cancel each other out

22.0 Landscape and Seascape

22.1 Introduction

The deployment of surface piercing tidal turbines or electrical infrastructure at sea (seascape) are in areas where potential visual effects may result from the proposed development and therefore a Seascape, Landscape and Visual Impact Assessment (SLVIA) is required.

22.2 Current Knowledge

22.2.1 Guidance

The SLVIA will be undertaken in accordance with guidance provided in the following documents:

- Landscape Institute and Institute of Environmental Management (2013). Guidance for Landscape and Visual Assessment: Third Edition;
- Countryside Agency and Scottish Natural Heritage (SNH). (2002). Landscape Character Assessment: Guidance for England and Scotland;
- SNH (2012). Offshore Renewables – guidance on assessing the impact on coastal landscape and seascape, Guidance for Scoping an Environmental Statement;
- Alison Grant, Landscape Architects for SNH, (2011). The siting and design of aquaculture in the landscape: visual and landscape considerations;
- SNH (2012). Offshore Renewables – guidance on assessing the impact on coastal landscape and seascape;
- Enviros for the DTI, (2005). Guidance on the Assessment of the Impact of Offshore Wind Farms: Seascape and Visual Impact Report;
- Countryside Council for Wales (CCW), Brady Shipman Martin and University College of Dublin (UCD), (2001). Guide to Best Practice in Seascape Assessment;
- Landscape Institute Advice Note 01/2011 (2011). Photography and Photomontage in Landscape and Visual Assessment;
- University of Newcastle. Commissioned Report F01AA303A (2002). Visual Assessment of Windfarms: Best Practice, and
- SNH (2007). Visual Representation of Windfarms: Good Practice Guidance

Landscape, seascape and visual assessments are separate, though linked procedures. The assessment of the potential effect on the landscape is carried out as an effect on the environmental resource (i.e. the landscape). Visual effects are assessed as an inter-related effect on population.

Landscape effects derive from changes in the physical landscape which may give rise to changes in its character and how this is experienced.

Visual effects relate to changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes and to the overall effects with respect to visual amenity. The aim of the landscape and visual assessment is to identify, predict and evaluate potential key effects arising from the proposed development. Wherever possible, identified effects are quantified, but the nature of landscape and visual assessment requires interpretation by professional judgement. In order to provide a level of consistency to the assessment, the prediction of magnitude and assessment of significance of the residual landscape and visual effects will be based on pre-defined criteria.

Seascape assessment is concerned with the interaction of the sea, coast and land and how a proposed development relates to this combination. Without exception 'seascape' will exist in a coastal landscape context and influence its character. This approach has been adopted in Department of Trade and Industry (DTI) Guidance which notes that every seascape comprises three components.

- the seaward = an area of sea
- the coastline = a length of coastline; and
- the landward = an area of land

The term SLVIA is commonly used to refer to Seascape, Landscape and Visual Assessment, but it must be emphasised that the process of LVIA – Landscape and Visual Assessment, remains the accepted methodology underpinning the assessment.

22.2.2 Landscape

Northern Ireland Environment Agency (NIEA) in association with the Planning Service commissioned a survey which resulted in the identification of 130 distinct landscape areas in Northern Ireland. The nearest landfall to the tidal site is called The Causeway Coast and Rathlin Island and features the following characteristics:

- Narrow coastal strip on the northern slopes of the Antrim Plateau.
- Dramatic cliffs with igneous intrusions giving rise to prominent headlands and sheltered bays.
- Small scale rough pastures and rocky moorland cling to the steep coastal edge.
- Degraded round stoned walls and derelict stone farmhouses.
- Historic features are important on Fair Head.
- Coastal road winds precariously along the cliff edge linking, small stone cottages with dramatic seaward views.

This landscape type forms part of a wider area designated as an Area of Outstanding Natural Beauty called "The Antrim Coast and Glens AONB" and contains a varied landscape including Northern Irelands only inhabited offshore island, gentle bays and valleys, dramatic headlands, farmland and the wild open expanse of moorland on the plateau. Added to this the area has a long settlement history with many important archaeological sites, listed buildings, historic monuments and conservation areas.

22.2.3 Seascape

It is noted that there is currently no specific seascape assessment guidance available for marine devices. However, the combination of the above guidance does encourage consistency and good practice in seascape assessment across a range of developments.

With reference to the NI SEA Appendix E, Seascape Assessment, the baseline assessment identified the area adjacent to the AOI as a Seascape Type 6 –

Complex Indented Coast, Small Bays and Offshore Islands with the following physical characteristics:

"Typically this seascape contains a varied, complex and incised coastline with steep, undulating hinterland, small bays and cliffs. Along the Causeway Coast and Rathlin Island where the drama of high cliffs, sea blown arches and rugged coastal massif separates the narrow coastal strips and shallow bays from the high plateaus beyond the coastline has a distinct shelf, often rocky with associated islands and rocky knolls. Headlands and raised beaches harbour small bays. In some locations the hinterland consists of a drumlin landscape which rolls down to meet a deeply indented shoreline."

22.3 Potential Effects

22.3.1 Installation

This is a temporary effect for the tidal site associated with the presence of construction vessels and equipment.

22.3.2 Operation

There may be visibility of the tidal site from potentially sensitive viewpoints and there is the potential for the proposed development to influence the seascape.

22.3.3 Decommissioning

Decommissioning effects are likely to be as per installation though over a shorter period of time.

22.4 Scope and Methodology – Landscape and Seascape

22.4.1 Seascape (Tidal Farm)

Although it is possible that non surface penetrating devices may be selected for the development, a Seascape EIA is proposed.

The Landscape Institute and Institute of Environmental Management (2013) sets out accepted and well established assessment methodology for LVIA. The character assessment process for seascapes and coastal landscapes is essentially the same. However, in applying the guidelines it is important to consider the key qualities and issues that are specific to the marine and coastal environment, for example the conjunction of land, intertidal areas and open seas; the shape and scale of coastline; views from the coast and views from the sea whether from ferries, sailing boats or sea-kayaks. These are the key issues that differ from those usually considered in a landscape and visual assessment; **it is not the method of impact assessment itself that differs**

The baseline coastal landscape and seascape character are both the 'seaward' and the 'landward' elements which includes elements and experiential qualities that are distinctive and typify the place. Seascape effects are the changes in the character and quality of the seascape as a result of development. Hence seascape assessment is concerned with direct and indirect effects upon specific seascape elements and features; more subtle effects on seascape character; and effects upon acknowledged special interests such as designated landscapes for their scenery, wildness or tranquillity. With offshore renewable projects the majority of the development is not on a landscape, so consideration has been given to the indirect visual effects on the setting or perception of coastal landscapes as a result of offshore development, as well as the landscape effects arising from the land based development components such as the substation and grid connections.

The assessment will be undertaken following consultation with DoE MD and NIEA and will use best practice guidance above and section 5.1 of Appendix E, Seascape Assessment of the NI SEA. The following summary methodology and approach are proposed.

Seascape effects will be assessed within a 15km radius study area. A seascape character assessment will establish the baseline conditions, and examine the sensitivity of the seascape and surrounding study area to change associated with the development of a tidal farm.

Visual effects will be assessed using a Zone of Visual Influence (ZVI) map and a viewpoint analysis. A draft ZVI will be prepared to a 15km radius, which will indicate the theoretical visibility of the proposed tidal farm. The visibility from receptors will be described and a viewpoint assessment carried out to determine the effect of the tidal farm on specific receptors and viewpoints in the study area.

- Desk Study;
- Initial Field Survey;
- Preliminary Identification of Viewpoints to be Included in the SLVIA;
- Confirmation of the Scope and Methodology with DoE MD NIEA and The Planning Service;
- Detailed Field Survey and Photography;
- Seascape Character Assessment;
- Seascape and Visual Impact Assessment;
- Identification of Mitigation Measures Including Design Layout;
- Reporting on Residual Seascape and Visual Impacts and their Significance;
- Confirmation of Layout with Representatives from NIEA and The Planning Service prior to Submission of a planning application.

The SLVIA will be supported by a series of illustrations including a Seascape Character Assessment Plan, ZVI's, photomontages and wireline diagrams showing existing and predicted views of the proposed tidal farm at specific locations in the study area.

22.4.3 Cumulative Impact Assessment (CIA)

A combined Landscape/Seascape CIA will be to include other developments either built or in the public domain likely to have a visual effect on the seascape.

Section 5: Summary

23. Summary

Photographer - Kathleen McNeilly

23.0 Summary

23.1 Identification of Potential Impacts

The scoping exercise assists in identifying potential impacts. The initial overview provides an indication of the type of environment in which the project takes place so along with the project description it is then possible to make an initial appraisal of potential impacts and their relevance to the project. Comments from consultees will also identify potential impacts to aid further assessment.

Following receipt of the Scoping Opinion, (DoE MD & DETI combined response to this Scoping Document) the proposed scope of the EIA will be reviewed in light of the content of the Scoping Opinion and will be amended if required.

23.2 Scope of the EIA

It is considered that the EIA scope will provide a robust appraisal of the likely significant effects of the project on the environment by:

- Establishing and reviewing the existing environmental conditions within the licence area and surrounding environment;
- Identifying and assessing any likely significant environmental impacts associated with the project; and
- Assisting in the identification of appropriate measures to mitigate any significant adverse impacts.

Table 23.1 presents a summary of the potential environmental effects for each aspect of the development with regard to the environment that may be affected.

Aspect of Environment	Potential Environmental Effects		
	Installation	Operation	Decommissioning
Section 2: Physical Environment			
Seabed Bathymetry	No significant effect	Changes in sediment transport. Impacts will depend on design & size of array, size of rotors, water depth & height of device above seabed.	No significant effect
Geological Conditions	No significant effect	Scouring adjacent to foundations or buried or protected cables could be a feature	No significant effect
Contamination & Water Quality	Potential release of increased contaminant inherent in rock strata Release of grout into water column Leaks/spills of oils or lubricants from installation vessels Disturbance of contaminated sediments Indirect effects of increased sediment on water quality, benthic & fish ecology	Leaks/spills of oils or lubricants or antifouling coatings from inspection/maintenance vessels Scouring - producing sediments adjacent to foundations	Leaks/spills of oils or lubricants from decommissioning vessels
Section 3: Biological Environment			
Benthic	Substratum changes & loss of species Smothering Increased suspended sediment & turbidity Disturbance of contaminated sediments	Substratum loss Decrease in water flow Changes in suspended sediment levels and turbidity Potential for leaching of toxic compounds and leakage of hydraulic fluids	Effects similar to installation

Aspect of Environment	Potential Environmental Effects		
	Installation	Operation	Decommissioning
		Potential for colonisation of structures	
Fish & Shellfish	Disturbance	Collision Risk	Potential effects similar to installation
	Smothering	Substratum loss	
	Increased suspended sediment & turbidity	Decrease in water flow	
	Disturbance of contaminated sediments	Changes in suspended sediment levels and turbidity	
	Marine Noise	Contamination	
		EMF	
		Noise	
		Fishing Exclusion Areas	
		Barrier to Movement	
Birds	Disturbance	Collision Risk	Potential effects similar to installation
	Marine Noise	Marine Noise	
	Increased water turbidity	Disturbance	
	Seabed Habitat Change	Seabed Habitat Change	
	Pollution and Contamination	Pollution and Contamination	
		Lighting	
Marine Mammals	Injury and disturbance due to noise & construction vessels & activities	Injury and disturbance due to operational noise	Potential effects similar to installation
	Collision Risk	Displacement leading to habitat exclusion & barrier effects	
	Increased turbidity	Collision with operating turbines	
	Accidental release of contaminants	Collision risk with maintenance vessels	
	Indirect impacts of changes to prey resource	EMF	

Aspect of Environment	Potential Environmental Effects		
	Installation	Operation	Decommissioning
		Accidental release of contaminants Indirect impacts of changes to prey resource	
Section 4: Human Environment			
Marine and Coastal Historic Environment	Potential impacts on sites and artefacts Displacement/dumping of Waste Material	No significant effects	
Cables and Pipelines	Potential cable/pipe damage during installation	Cable pipe maintenance restriction	Potential effects similar to installation
Military Exercise Area	Potential Temporary disruption during installation	Potential for noise emissions to mask noise from other sources	Potential effects similar to installation
Disposal Sites	Disturbance	Potential for disposal exclusion	Potential for disposal exclusion
Commercial Shipping and Navigation	Increased journey times and distances Displacement of Shipping Density Reduced Trade Opportunities Reduced Visibility Collision Changes to Search and Rescue operations	Potential effects similar to installation	Potential effects similar to installation
Recreation, Tourism & SocioEconomic	Noise Transportation Landscape, Seascape and Visual Amenity Access Restrictions	Noise Landscape, Seascape and Visual Amenity Safety & Collision Risk Access Restrictions	Potential effects similar to installation

Aspect of Environment	Potential Environmental Effects		
	Installation	Operation	Decommissioning
	Water Quality	Disturbance to Wildlife Energy Extraction & Effects on Coastal Areas & Beaches Creation of Tourist Attractions	
Landscape and Seascape	Presence of construction vessels and equipment	Potential for the development to influence the seascape	Potential effects similar to installation

Table 23.1: Summary of Potential Environmental Effects

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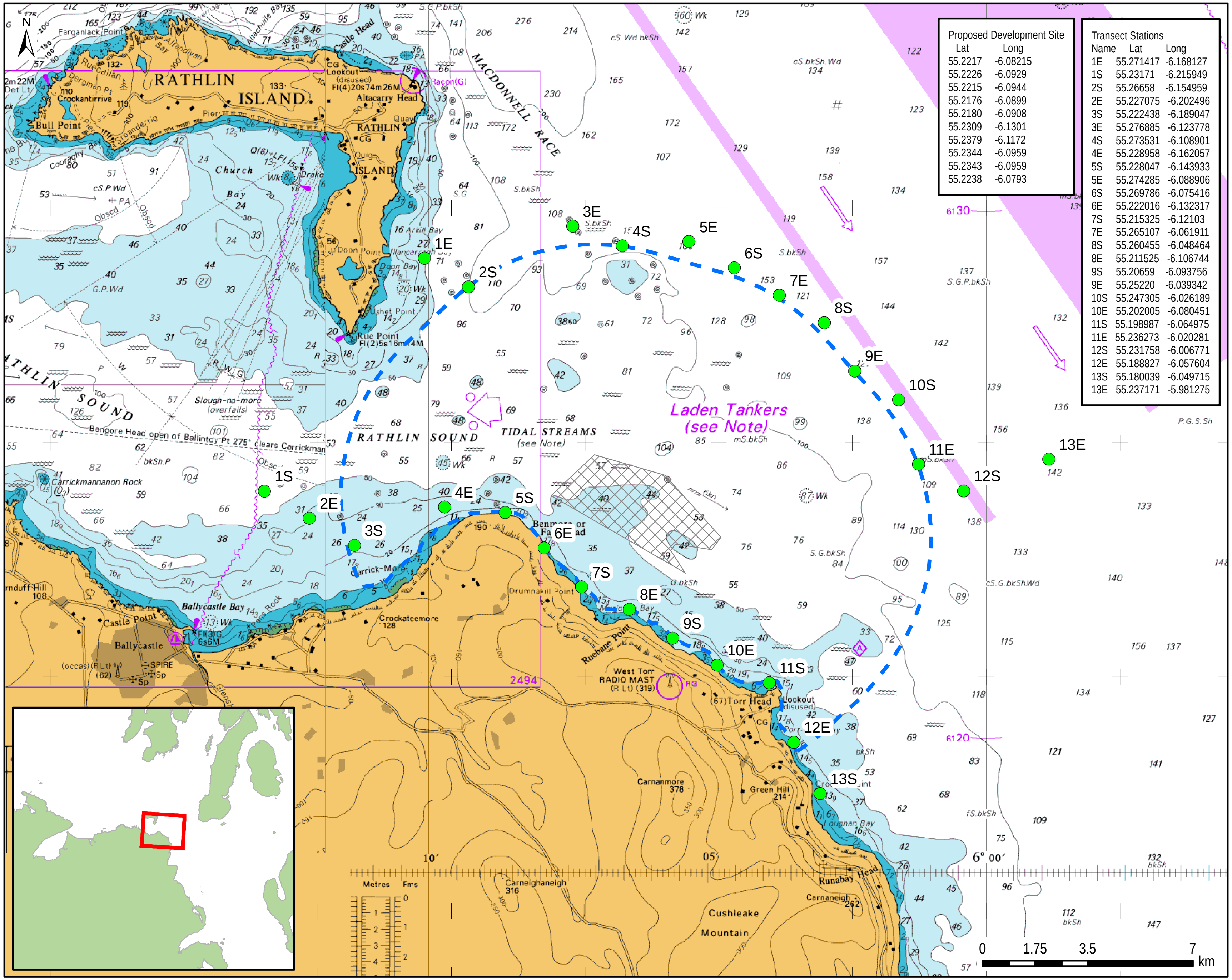
Appendix 1: Figures



Proposed Development Site	
Lat	Long
55.2217	-6.08215
55.2226	-6.0929
55.2215	-6.0944
55.2176	-6.0899
55.2180	-6.0908
55.2309	-6.1301
55.2379	-6.1172
55.2344	-6.0959
55.2343	-6.0959
55.2238	-6.0793

Transect Stations		
Name	Lat	Long
1E	55.271417	-6.168127
1S	55.23171	-6.215949
2S	55.26658	-6.154959
2E	55.227075	-6.202496
3S	55.222438	-6.189047
3E	55.276885	-6.123778
4S	55.273531	-6.108901
4E	55.228958	-6.162057
5S	55.228047	-6.143933
5E	55.274285	-6.088906
6S	55.269786	-6.075416
6E	55.222016	-6.132317
7S	55.215325	-6.12103
7E	55.265107	-6.061911
8S	55.260455	-6.048464
8E	55.211525	-6.106744
9S	55.20659	-6.093756
9E	55.25220	-6.039342
10S	55.247305	-6.026189
10E	55.202005	-6.080451
11S	55.198987	-6.064975
11E	55.236273	-6.020281
12S	55.231758	-6.006771
12E	55.188827	-6.057604
13S	55.180039	-6.049715
13E	55.237171	-5.981275

FAIRHEAD TIDAL

FIGURE 5.1

Fair Head Tidal Energy Site

- Transect Stations
- Proposed Development Site
- Proposed Development Site 4km Buffer

Date	By	Size	Version
Oct 13	MCE	A4	1

Coordinate System	WGS 1984 Web Mercator
Projection	Mercator
Scale	1:3,071,355
QA	NJG

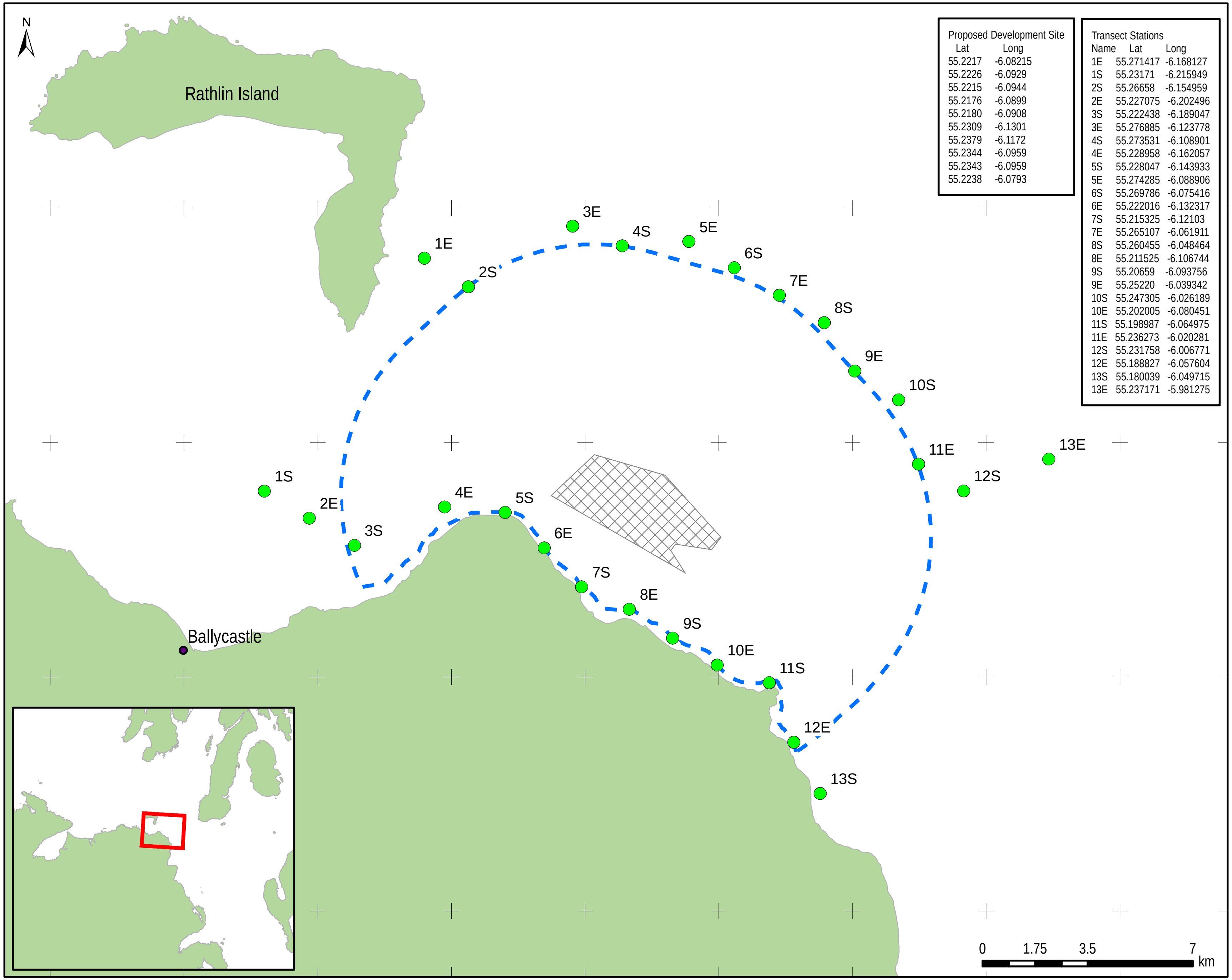
4081-04_Fig5.1_FH_Tidal_Energy.mxd

Produced by ABPmer

Data Sources: UKHO
NOT TO BE USED FOR NAVIGATION

ABP mer marine environmental research

DP ENERGY MARINE



Proposed Development Site

Lat	Long
55.2217	-6.08215
55.2226	-6.0929
55.2215	-6.0944
55.2176	-6.0899
55.2180	-6.0908
55.2309	-6.1301
55.2379	-6.1172
55.2344	-6.0959
55.2343	-6.0959
55.2238	-6.0793

Transect Stations

Name	Lat	Long
1E	55.271417	-6.168127
1S	55.23171	-6.215949
2S	55.26658	-6.154959
2E	55.227075	-6.202496
3S	55.222438	-6.189047
3E	55.276885	-6.123778
4S	55.273531	-6.108901
4E	55.228958	-6.162057
5S	55.228047	-6.143933
5E	55.274285	-6.088906
6S	55.269786	-6.075416
6E	55.222016	-6.132317
7S	55.215325	-6.12103
7E	55.265107	-6.061911
8S	55.260455	-6.048464
8E	55.211525	-6.106744
9S	55.20659	-6.093756
9E	55.25220	-6.039342
10S	55.247305	-6.026189
10E	55.202005	-6.080451
11S	55.198987	-6.064975
11E	55.236273	-6.020281
12S	55.231758	-6.006771
12E	55.188827	-6.057604
13S	55.180039	-6.049715
13E	55.237171	-5.981275

FAIRHEAD TIDAL

FIGURE 5.2

Fair Head Tidal Energy Site

- Transect Stations
- Proposed Development Site
- Proposed Development Site 4km Buffer
- UK Towns & Cities

Date	By	Size	Version
Oct 13	MCE	A4	1

Coordinate System	WGS 1984 Web Mercator
Projection	Mercator
Scale	1:180,000
QA	NJG

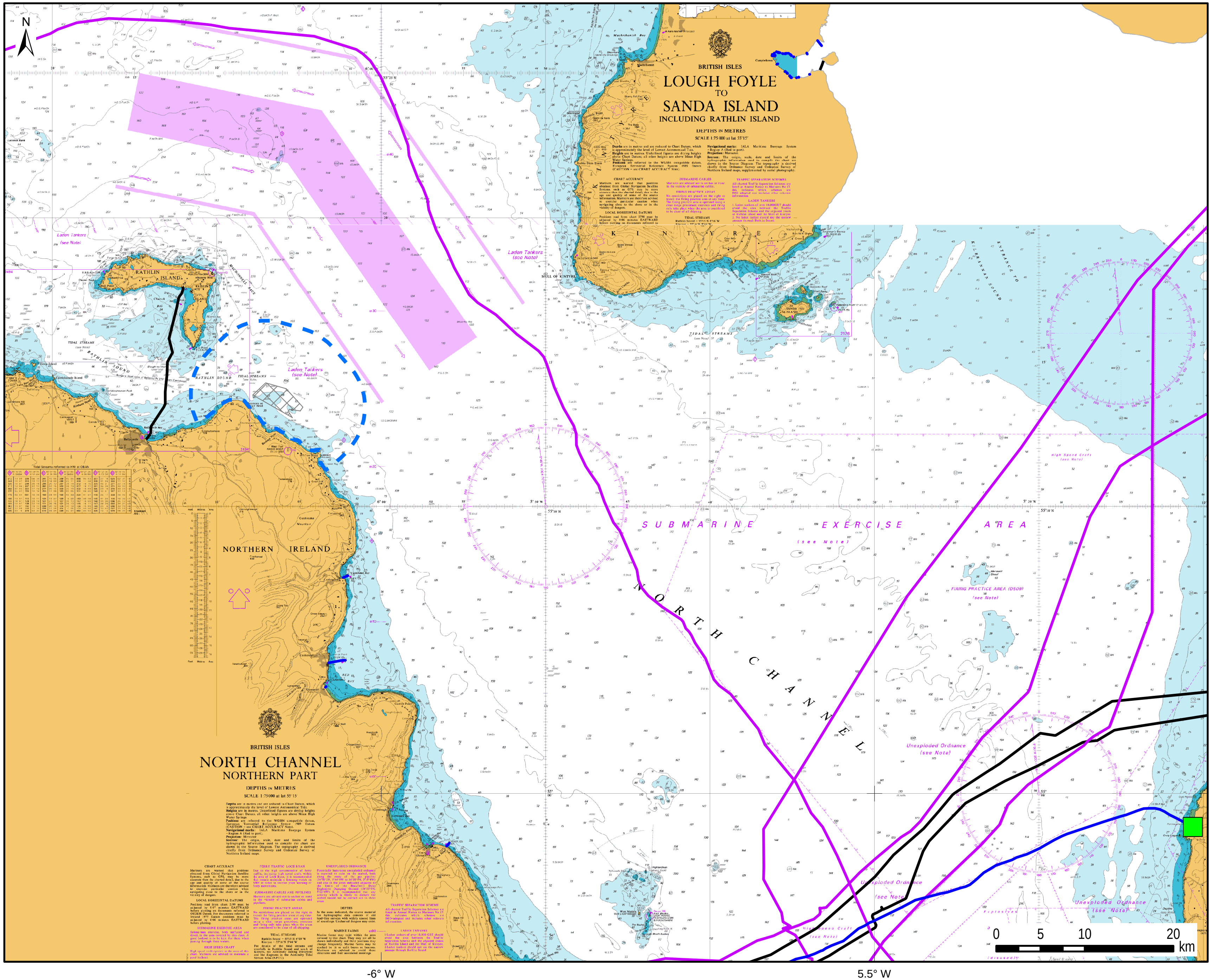
4081-04_Fig5.2_FH_Tidal_Energy.mxd

Produced by ABPmer

Data Sources: ESRI, DP Energy Ireland
NOT TO BE USED FOR NAVIGATION

ABP mer marine environmental research

DP ENERGY MARINE



FAIRHEAD TIDAL

FIGURE 15.1

Cables and Pipelines around Northern Ireland

- Proposed Development Site 4km Buffer
- Proposed Development Site
- Oil Terminal
- Power Cable
- Telecommunication Cable
- Pipeline

Date	By	Size	Version
Nov 13	MCE	A4	1

Coordinate System	WGS 1984 Web Mercator
Projection	Mercator
Scale	1:600,000
QA	NJG

4081-04_Fig15.1_Cables_Pipes.mxd

Produced by ABPmer

Data Sources: KISCA

NOT TO BE USED FOR NAVIGATION

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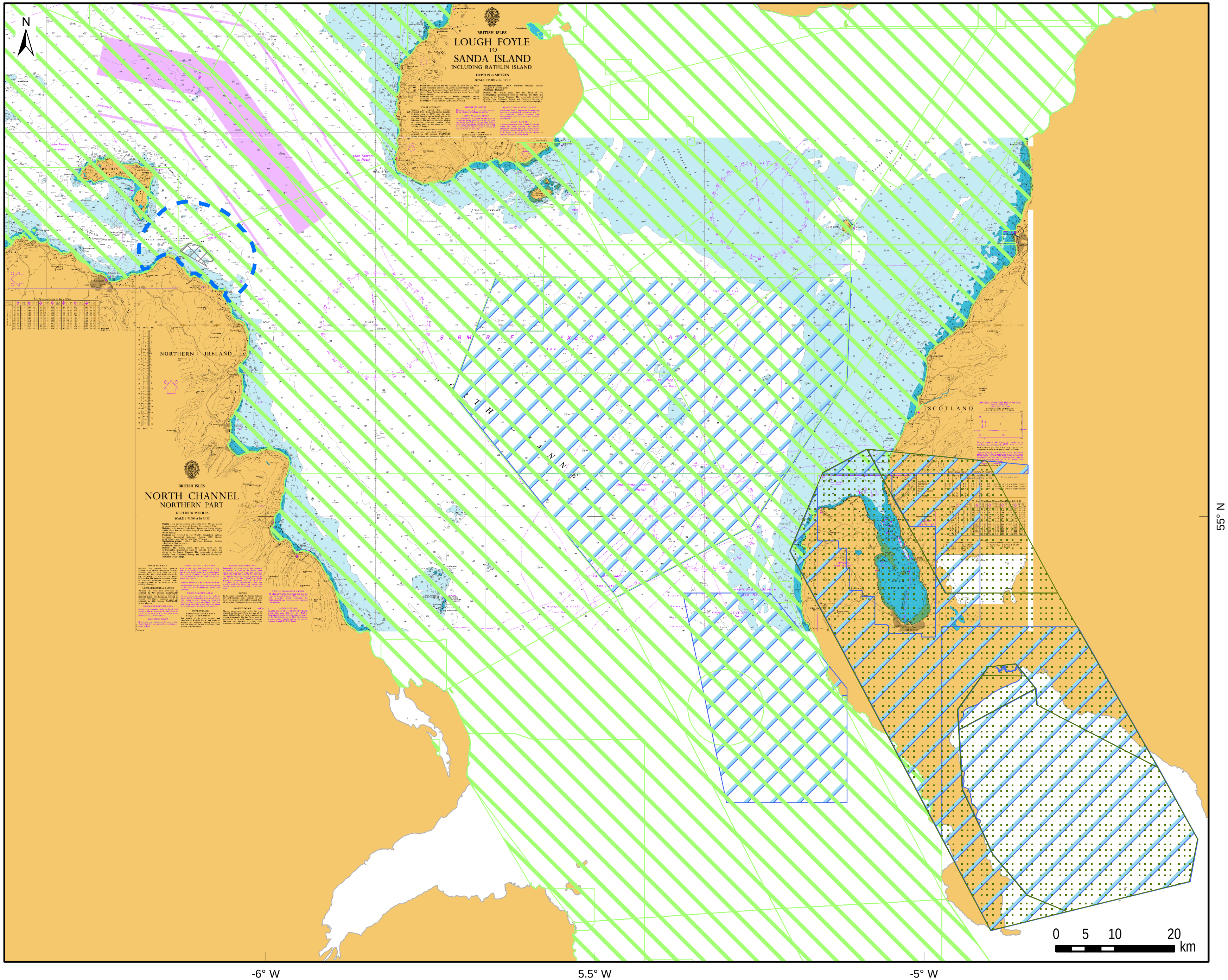
DP ENERGY MARINE

FAIRHEAD TIDAL

FIGURE 16.1

Military Practice and Exercise Areas



- Proposed Development Site 4km Buffer
- Proposed Development Site
- Excercise Areas
- Bombing Exercises
- Firing Danger Area

Date	By	Size	Version
Nov 13	MCE	A4	1
Coordinate System	WGS 1984 Web Mercator		
Projection	Mercator		
Scale	1:900,000		
QA	NJG		
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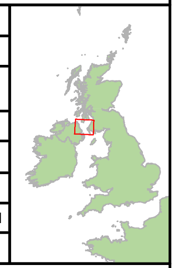

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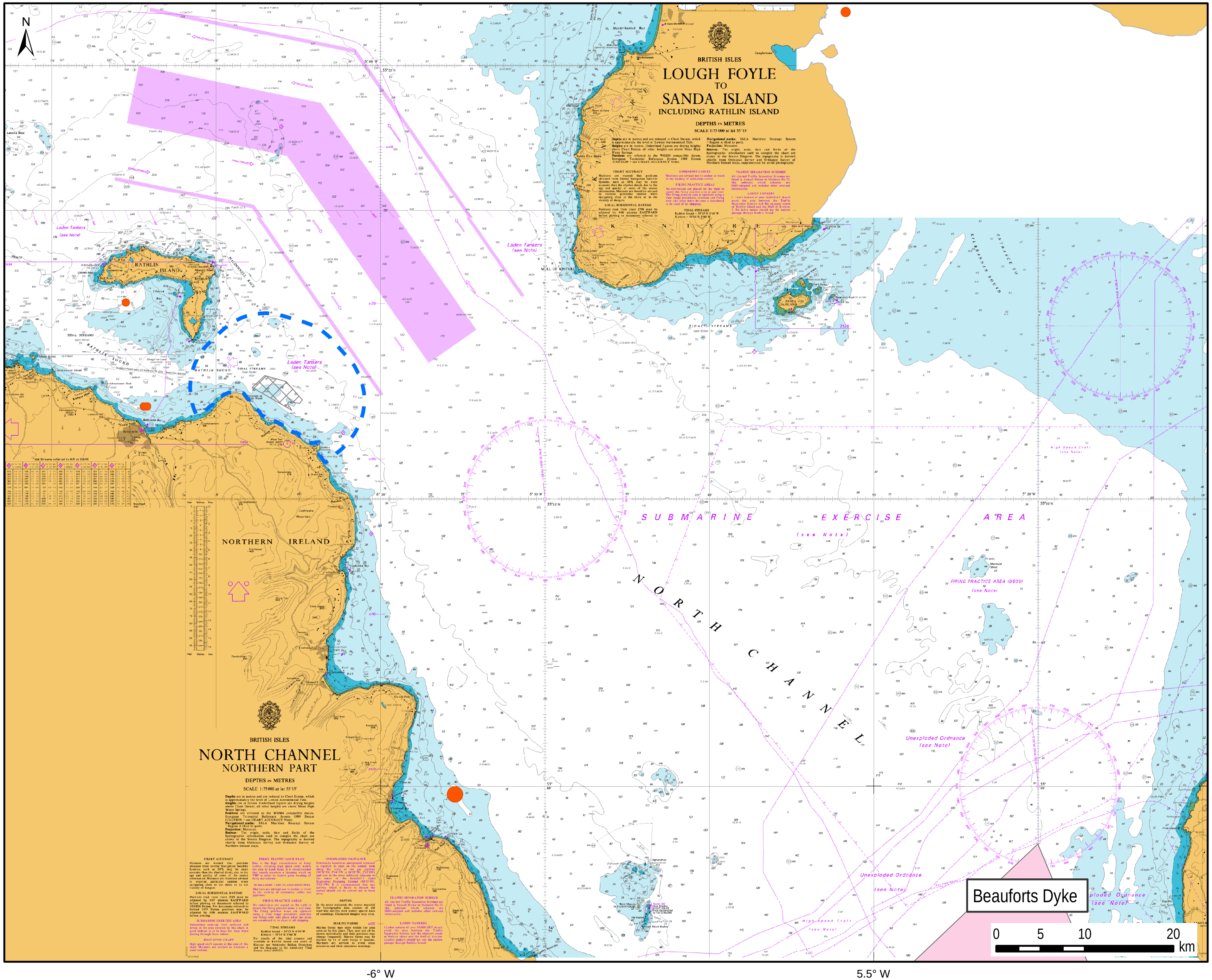
MARINE



FAIRHEAD TIDAL

FIGURE 17.1

Disposal Sites

Proposed Development Site 4km Buffer

Proposed Development Site

Waste Disposal Sites

Explosives Dumping Ground

Spoil Ground

Date	By	Size	Version
Nov 13	MCE	A4	1

Coordinate System	WGS 1984 Web Mercator
Projection	Mercator
Scale	1:600,000
QA	NJG

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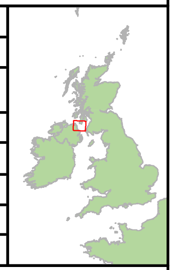

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Appendix 2: Survey Programme for Seabirds and Marine Mammals at Fair Head Tidal Energy Site.

Survey Programme for

Seabirds and Marine Mammals at Fair Head Tidal Energy Site for DPME and DEME

16th October 2013

1. INTRODUCTION

DP Marine Energy Ltd (DPME) and DEME Blue Energy (DBE) are preparing an application for consent to develop a 100MW tidal energy project off Fair Head, on the north Antrim Coast of Northern Ireland. DPME and DBE have contracted SAMS Research Services Ltd (SRSL) and Natural Research Projects Ltd (NRP) to prepare a survey design and methods for gathering information on marine mammals and seabirds respectively. The surveys will also collect information on basking shark and marine turtles. Because the visual survey technique lends itself towards the identification of these animals, for the purposes of this report basking shark and turtles are treated as marine mammals. All references to the term “marine mammal” should be assumed to include these species unless otherwise stated. The primary purpose of the surveys is to characterise the use made by marine mammal and seabird species of the proposed development area and a surrounding buffer to inform the assessment of impacts on these species through the consenting process.

This report considers the design and methods of surveys for seabirds and marine mammals. The surveys proposed for these two taxonomic groups are considered together because they have several features in common. In particular, the boat-based survey for the two taxonomic groups will be conducted simultaneously from the same vessel and following the same survey design layout, and shore-based studies will be undertaken from the same locations.

This report first presents the results of the desk-based review of existing data on marine mammals. The report considers the aspects of the surveys that are common to both seabirds and marine mammals, before going on to examine the methods to be used for each. The design for boat-based surveys addresses the spatial and temporal considerations of the visual and acoustic (marine mammals only) surveys to be undertaken on a regular basis throughout the year to obtain density estimates for key species at the site. Shore-based observations and stationary passive acoustic data collection strategies are also discussed.

2. SUMMARY OF EXISTING DATA

The process of identifying which species are likely to be present in the survey area, and their likely abundance and seasonality, is an important first stage in survey design. There is a substantial amount of general information on the occurrence of seabirds and marine mammals in coastal waters of Northern Ireland. This information gives a good insight into likely use made by each species of the Fair Head area.

2.1 Seabirds

In the case of seabirds, two sources of information are particularly useful for giving an overview of the expected value of the area to each seabird species. These are the national Seabird Monitoring Program database on breeding seabird colonies maintained by the Joint Nature Conservation Committee (JNCC) (Website, and summarised in Mitchell *et al*. 2004) and the published maps of at sea seabird distribution and abundance based on a synthesis of ESAS and aerial survey data obtained over many years from around the UK (e.g. Kober *et al.* 2010). In addition there are numerous tagging studies that reveal the extent of foraging ranges made by seabirds from colonies (e.g. Thaxter *et al.* 2012).

Based on the results in Kober *et al.* 2010 and Mitchell *et al.* 2004, the expected status of seabirds in the Fair Head area is summarised in Table 1. This shows that around 21 species of seabird are expected to occur. Ten of these species are expected to occur at very low densities and the area is likely to have very low importance for these species. It also shows that nearby (approximately 10 km away) Rathlin Island is the closest breeding colony for many species.

In the breeding season, four species are expected to occur at moderate or high relative densities, namely kittiwake (*Rissa tridactyla*), common guillemot (*Uria aalge*), razorbill (*Alca torda*) and black guillemot (*Cepphus grylle*). These are all species that breed in relatively large numbers on Rathlin Island. Rathlin Island also holds small numbers of breeding puffin (*Fratercula arctica*), shag (*Phalacrocorax aristotelis*), fulmar (*Fulmarus glacialis*) and herring gull (*Larus argentatus*), lesser black-backed gull (*L. fuscus*) and great black-backed gull (*L. marinus*) and is the most likely origin for the low numbers of these species expected to be present in the spring and summer months.

In the autumn and winter months the range and numbers of seabirds present is expected to be smaller, reflecting the seasonal movement undertaken by many seabird species. No species is expected to be present in high relative densities at this time of year. Five species are expected to occur in moderate relative densities in the autumn and winter, namely common guillemot, razorbill and black guillemot, herring gull and great black-backed gull. With the exception of black guillemot, the individuals of these species present in autumn and winter are likely to originate outside the local breeding area, in particular breeding sites in Scotland and overseas such as in Iceland.

Table 1. The expected status of seabirds in the Fair Head survey area based on existing information. The density category is derived from Kober *et al.* (2010) and is relative to the range of densities reported for that species across UK waters. The breeding colony information is based on results of the Seabird 2000 census (Mitchell *et al*. 2004).

Species	Breeding season density	Autumn and winter density	Nearest important breeding colony and distance (km)
Northern fulmar (*Fulmarus glacialis*)	Very low	Very low	Rathlin Island, 10 km
Manx shearwater (*Puffinus puffinus*)	Low	Absent	Copeland Islands, 73 km
Sooty shearwater (*Puffinus griseus*)	Very low	Absent	Breeds in South Atlantic
European storm petrel (*Hydrobates pelagicus*)	Very low	Absent	Sanda, 33 km
Northern gannet (*Morus bassanus*)	Low	Low	Ailsa Craig, 62 km
Cormorant (Phalacrocorax carbo)	Very low	Very low	Sheep Island, 15 km
European shag (Phalacrocorax aristotelis)	Low	Very low	Rathlin Island, 10 km
Arctic skua (*Stercorarius parasiticus)*	Very low	Absent	Treshnish Islands, 140 km
Great skua (Stercorarius skua)	Low	Very low	Mingulay, 200 km
Black-footed kittiwake (*Rissa*	Moderate	Low	Rathlin Island, 10 km

Species	Breeding season density	Autumn and winter density	Nearest important breeding colony and distance (km)
tridactyla)			
Great black-backed gull (*Larus marinus*)	Low	Moderate	Rathlin Island, 10 km, (small numbers)
Herring gull (Larus argentatus)	Low	Moderate	Rathlin Island, 10 km, (small numbers)
Lesser black-backed gull (*Larus fuscus*)	Very low	Very low	Rathlin Island, 10 km, (small numbers)
Sandwich tern (Sterna sandvicensis)	Very low	Absent	Blue Circle Island, Larne Lough, 56 km
Arctic tern (Sterna paradisaea)	Very low	Absent	Copeland Islands, 73 km
Common tern (*Sterna hirundo*)	Very low	Absent	Blue Circle Island, Larne Lough, 56 km
Common guillemot (*Uria aalge*)	High	Moderate	Rathlin Island, 10 km
Razorbill (*Alca torda*)	High	Moderate	Rathlin Island, 10 km
Puffin (Fratercula arctica)	Low	Low	Rathlin Island, 10 km, (small numbers)
Black guillemot (*Cepphus grylle*)	Moderate	Moderate	Rathlin Island, 10 km
Little auk (*Alle alle*)	Absent	Very low	Breeds in Arctic latitudes
All seaduck species	Absent	Absent	Habitat apparently unsuitable

2.2 Basking Shark

Basking sharks (*Cetorhinus maximus*) have been recorded in waters around Ireland for centuries, supporting commercial fisheries at various times (Berrow *et al*. 1994). Basking sharks are highly migratory and closely track seasonal and inter-annual shifts in zooplankton aggregations (Sims & Quayle 1998; Sims & Reid 2002; Sims *et al*. 2003). These large-scale movements make basking sharks very wide ranging, exploiting both plankton-rich areas out to the edge of the European shelf in addition to tidal fronts that aggregate zooplankton in coastal areas (Bloomfield & Solandt 2007). Tidal fronts around the north Antrim coast sites therefore represent areas where basking sharks are most likely to occur, and they have been reported in large aggregations from around the north Antrim coastline (Dr. A. Mellor, AFBI; *pers comm*) and around Rathlin (AFBI 2009).

In UK and Irish waters the Inner Hebrides, along with the Clyde Sea, Isle of Man and inshore waters around Devon and Cornwall, are known hotspots for basking sharks based on the high densities of sharks found in these areas (Southall *et al*. 2005). Compared to these hotspots, sightings in the North Channel and off the Antrim coast are less common, although historical data suggest a concentration of sightings along the north Antrim coast (ICES block IVb; Berrow & Heardman 1994; Southall *et al*. 2005; Bloomfield & Solandt 2007). IWDG data identify 22 records in the last 10 years in the immediate area of the proposed development site with mainly solitary sightings (IWDG 2013).

The lower sighting densities found around the north Antrim coast suggest the area may not be as an important for basking sharks as other parts of the Irish Sea such as around the Clyde and the Isle of Man. However, as much of the data are based on public sightings instead of systematic surveys, the results should be interpreted with caution. In particular, the wide-ranging movements that basking sharks undertake in response to changes in zooplankton also mean that sharks can show large changes in distribution on an annual basis. There is also the potential for sharks to migrate through the North Channel on their way to/from known aggregation sites in the Hebrides.

2.3 Cetaceans

Cetaceans can be broadly classified into two groups, Odontocetes (toothed whales) and Mysticetes (baleen whales), based on their foraging methods. The cetacean fauna of Northern Ireland is considered to be moderately rich (Reid *et al*. 2003; O'Brien *et al*. 2009; IWDG 2013). More than 15 species of cetaceans have been recorded in the nearshore waters of Northern Ireland (within 60 km of the coast), although only harbour porpoise (*Phocoena phocoena)*, short-beaked common dolphin (*Delphinus delphis)*, and bottlenose dolphin (*Tursiops truncatus)* can be considered as frequently occurring through much of the year, and minke whale (*Balaenoptera acutorostrata)* occurring regularly as a seasonal visitor. Risso's dolphin (*Grampus griseus)* and killer whale (*Orcinus orca)* can be considered uncommon visitors (Reid *et al*. 2003; O'Brien *et al*. 2009; IWDG 2013). The present document has focused on these more common species for the sake of brevity, but survey techniques included in this proposal will likely be able to detect other species in the less likely event of their presence in the survey area (Dunlop & Mellor 2008).

2.3.1 Harbour Porpoise

The harbour porpoise is distributed in all temperate and sub-arctic seas of the Northern Hemisphere (primarily in waters with a mean temperature between 5-14°C). The harbour porpoise is the most commonly recorded cetacean in UK waters, primarily occurring on the continental shelf[8]. In coastal waters, they are often encountered close to islands and headlands with strong tidal currents, with some evidence for seasonal movement in parts of the species' range (e.g. Pierpoint 2008; SCANS-II 2008; Marubini *et al*. 2009). Typically harbour porpoise occur as solitary animals or in small groups, but occasionally larger aggregations are reported (Reid *et al*. 2003).

Harbour porpoises are distributed widely in the North Channel and offshore from the Antrim coast, but there is relatively little information on small-scale harbour porpoise abundance and distribution at the proposed site. IWDG data identify 73 records in the last 10 years in the immediate area of the proposed development site with groups as large as 24 individual animals (IWDG 2013). Surveys in coastal waters off Northern Ireland in July 2004 estimated harbour porpoise abundance and mean density as 387 individuals (95% CI = 170-877) and 0.387 individuals/km^2, respectively (Goodwin & Speedie 2008). During the most recent large-scale SCANS-II survey (SCANS-II 2008) across most of the European continental shelf area, the northern coast of Northern Ireland around the proposed site was surveyed together with western Scottish waters up to Cape Wrath and outwards to the Outer Hebrides (Survey block N). Across this entire area, estimated porpoise abundance was 12,076 with an average estimated density of 0.3943 animals/km^2.

Coastal waters of Northern Ireland have received attention as a possibly significant area for harbour porpoise (e.g. Evans & Wang 2008; Clark *et al*. 2010). In a UK first, in 2012 the Skerries and Causeway candidate SAC was proposed with harbour porpoise as a "Qualifying Feature", suggesting that this area is important to large numbers of harbour porpoises.

2.3.2 Bottlenose dolphin

The bottlenose dolphin has a worldwide distribution in tropical and temperate seas of both hemispheres, in both shelf and coastal waters. In coastal waters, bottlenose dolphins favour river estuaries, headlands and sandbanks, mainly where there is uneven bottom relief and/or strong tidal currents (Reid *et al.* 2003; SCANS-II 2008). Bottlenose dolphins are a social dolphin, commonly forming groups of 2-25 individuals with larger schools occurring in offshore areas (Reid *et al.* 2003). Bottlenose dolphins in the North Atlantic appear to occur in two forms, coastal and offshore. The better known coastal form is locally common in the Irish Sea (particularly Cardigan Bay) and off north east Scotland (particularly the inner Moray Firth), the west coast of Ireland (e.g. the Shannon estuary, co. Galway/Mayo) and in smaller numbers in the Hebrides (west Scotland) and off south west England. Little is known about the offshore form of bottlenose dolphins, including the relationship between the offshore and coastal forms. More detailed studies in the North West Atlantic suggest that inshore and offshore populations are ecologically and genetically discrete (Hoelzel *et al.* 1998).

During the most recent large-scale SCANS-II survey across most of the European continental shelf area, the northern coast of Northern Ireland around the proposed site was surveyed together with western Scottish waters up to Cape Wrath and outwards to the Outer Hebrides (Survey block N; SCANS-II 2008). Across this entire area, estimated bottlenose dolphin abundance was 246 with an average estimated density of 0.080 animals/km^2. A more precise assessment of bottlenose dolphins in the Hebrides (the nearest resident population to the north Antrim coast) suggests that in total there may be approximately 45 (95% C.I.: 33-66) bottlenose dolphins in inshore waters, split between a widespread Inner Hebrides group of approximately 30 animals, and a localised group of approximately 15 animals around Barra in the Outer Hebrides (Cheney *et al.* 2013). It is not clear whether either group strays into Northern Irish waters.

While effort-related sightings are few in the northern Irish Sea, the species is regularly sighted in summer off the Galloway coast of southwest Scotland, around the Isle of Man and north Anglesey (Reid *et al.* 2003). Bottlenose dolphins are also recorded in small numbers around the Northern Ireland coast with peak numbers and frequency of sightings in April, and August to September. Good sighting localities are around Copeland Island and the entrance to Belfast Lough (IWDG 2013). IWDG data identify 19 records in the last 7 years in the immediate area of the proposed development site with groups as large as 50 individual animals (IWDG 2013). Several bottlenose dolphins sighted along the north Antrim coast have also been identified at numerous locations around Ireland, suggesting the presence of a small highly mobile population in coastal Irish waters (O'Brien *et al.* 2009). This suggestion is consistent with data from the SCANS II survey, which reported abundance estimates of bottlenose dolphin of 313 individuals (CV=0.81) for coastal Ireland (SCANS-II 2008). Recently, connectivity was confirmed between bottlenose dolphin populations in the Moray Firth (eastern Scotland), the Inner Hebrides and Irish waters, implying that these populations are not isolated from each other (Robinson *et al.* 2012).

2.3.3 Short-beaked common dolphin

The short-beaked common dolphin (*Delphinus delphis*), is primarily seen in the far south of the Irish Sea, particularly in summer (Reid *et al.* 2003; SCANS-II 2008; O'Brien *et al.* 2009). While this species has been recorded in the North Channel and waters of County Antrim (IWDG data identify 2 records in the last 10 years in the immediate area of the proposed development site), sightings are mainly offshore (IWDG 2013).

2.3.4 Minke whale

Minke whales (*Balaenoptera acutorostrata*) are the smallest and most abundant of the baleen whales encountered around the UK coast. They appear to favour areas of upwelling or strong tidal currents and are usually seen singly or in pairs but sometimes aggregate in greater numbers in areas where prey is abundant (Reid *et al*. 2003). Within UK waters, minke whales are most frequently sighted in the western central-northern North Sea, and west of Scotland around the Hebrides. Minke whales are occasionally observed in the North Channel and waters north of Co. Antrim, occurring mainly between July and October (IWDG 2013). IWDG data identify 7 records in the last 10 years in the immediate area of the proposed development site, mainly as solitary animals.

2.4 Pinnipeds

With regard to pinnipeds, both grey seal (*Halichoerus grypus*) and harbour seal (*Phoca vitulina*) breed at haulout sites along the Northern Ireland and adjacent Scottish coasts (SCOS 2012).

2.4.1 Harbour Seal

The harbour, or common, seal is the smaller of the two native UK seals measuring up to approximately 1.8 m in length. The UK is home to approximately 36,500 harbour seals, equivalent to 30% of the population of the European sub-species (having declined from approximately 40% in 2002). Scotland now holds approximately 80% of the UK population, with 15% in England and 5% in Northern Ireland (Duck & Morris 2011). Aerial surveys along the entire Northern Ireland coast in 2011 counted 948 harbour seals, down from 1,248 seals in 2002 (SCOS 2012); harbour seal numbers in Northern Ireland have been declining at an average annual rate of 3.0% (95% c.i. 2.4% - 3.7%) since 2002 (Duck & Morris 2011). The main concentrations of harbour seals were in Carlingford Lough, Dundrum, around Minerstown, Strangford Narrows, the Outer Ards (Ballywalter and Lisnevin), the Copeland Islands, Rathlin Island and in Lough Foyle (Duck & Morris 2011; SCOS 2012). Approximately 100 harbour seals were counted at the Rathlin Island haulout sites in 2011. Large colonies of harbour seals are also found along adjacent Scottish coasts including the Mull of Kintyre, Isle of Arran and Islay (SCOS 2012), and seals may regularly move between different haulout sites within a larger area, emphasising that Northern Ireland seals should be considered within a broader regional framework.

2.4.2 Grey Seal

The grey seal is the larger of the two seal species found in British waters, with males reaching a length of 2.4 m. About 111,300 grey seals, or 38% of the world population, are found in the UK and 88% of these breed in Scotland, mostly in the Outer Hebrides and Orkney (SCOS 2012). Grey seals often haul out in more exposed areas than harbour seals. Grey seals are less numerous in Northern Ireland waters than harbour seals, with the most recent aerial survey reporting 468 grey seals, and annual pup production estimated to be around 100 (Ó Cadhla *et al* 2007; Duck & Morris 2011). The main concentrations of grey seals in August 2011 were in Carlingford Lough, Dundrum, Strangford Narrows, North Rocks, the Outer Ards (Ballywalter and Lisnevin), the Copeland Islands, the Maidens and Rathlin Island (see Duck & Morris [2011] for further details). In several of these locations grey and harbour seals haul out at the same sites. Over the past decade there has, however, been a substantial increase in the numbers of grey seals recorded in Northern Ireland, particularly in the Outer Ards area. Approximately 20 grey seals were counted at the haulout sites on Rathlin Island in 2011 (Duck & Morris 2011). Large colonies of grey seals are also found along adjacent Scottish coasts including the Treshnish Isles, Colonsay/Oronsay and Islay (SCOS 2012), and seals may regularly move between different haulout sites within a larger area, again emphasising that Northern Ireland seals should be considered within a broader regional framework.

3. BOAT-BASED SURVEY DESIGN

The survey design presented below is a slightly revised version of an initial design prepared by NRP and SRSL in July 2013. The initial design has been revised in light of practical experience gained during two initial survey visits and following a meeting with NIEA and DoE in August 2013. Due to the wide ranging nature and generally low abundances of marine mammals at sea, there are recognised difficulties with presenting density estimates which are sufficiently accurate for the quantitative prediction of key impacts (e.g. encounter risk). It is therefore important to engage with the regulators at an early stage during survey design and, as survey results are forthcoming, to ensure that there is agreement on the likely use of the final outputs in supporting impact assessment and consequent decision making.

The situation for estimating the densities of seabird present is different. With the notable exception of the two skua species, the UK population sizes of all the seabird species listed in Table 1 are large; typically they numbers in the tens or hundreds of thousands of breeding birds, and over a million in the case of common guillemot (Mitchell *et al* 2004). Thus even species that are expected to occur at low density at Fair Head are likely to be encountered relatively frequently during surveys and thereby provide adequate data for estimating absolute abundance.

3.1 Design considerations

The project proposes the use of a single vessel from which to undertake visual seabird surveys as well as visual and passive acoustic surveys of marine mammals (the latter using a two-element towed hydrophone array). There are intrinsic difficulties concerning boat-based transect surveys of relatively small marine sites (such as that proposed at Fair Head). Apart from logistical problems in navigating a site with strong currents, these difficulties stem from the need to achieve sufficient sampling effort in the area of interest to give statistically robust results and meet the requirements for Distance sampling (Thomas *et al*. 2010). Given that marine mammals typically have far lower and more variable sighting rates than seabirds, SNH guidance (MacLeod *et al*. 2011) recommends basing survey design on expected marine mammal sighting rates, as this will likely allow seabird surveys to also achieve their objectives.

For the present survey design, key scientific considerations include the following:

- Sufficient effort should be undertaken to ensure as many as possible (ideally at least 60-80) detections per species of interest over the course of the entire survey programme.

- Each survey should contain a minimum of 20 independent transect lines, of which a minimum of 10 transect lines cover the proposed development site and immediately adjacent areas (see below).
- Transects should be orientated at right angles to major environmental gradients (see below).
- No transects should be excessively short, ideally they should all be a similar length.
- Transects should cover a surrounding buffer of up to 4km (see below).
- Consecutive transects should be at least 1km apart (see below).

Key logistical and economic considerations include the following:

- It should be possible to complete the survey design in a single day.
- The survey vessel will cover the ground at an average speed of 9-10 knots (approximately 16-19 km per hour).
- It is desirable to have a reduced design option for short day-length winter surveys.

For seabirds, an anticipated impact footprint (AIF) area (the region within which impacts from the development may be potentially significant) has been cautiously defined as extending 1 km beyond the area of interest to the proposed development. It is presently unclear whether this concept can be accurately defined in a similar way for marine mammals and basking sharks, given how much less is known about spatial scales over which different relevant impacts may operate on these species (e.g. disturbance due to sound outputs may well extend beyond 1 km around the site). For this reason, it has not been used in the marine mammal survey design to define an area beyond which impacts are considered negligible. Previous discussions with the regulator in a Scottish context (Marine Scotland), however, have suggested that there is a desire to ensure a sufficient degree of representativeness when designing surveys around a development site. One way this can be achieved is by ensuring that enough transects pass through the immediate neighbourhood of the proposed development site. For this reason, the present survey design has also aimed to include at least 10 transect lines which run across a 1 km-buffer zone around the proposed area of interest.

Orientation of transect lines at approximately right angles relative to environmental gradients is important to avoid high variance around resulting estimates. For marine mammals and basking sharks, relevant environmental gradients include distance from shore, bathymetry, current speed and direction. Consideration of the first two of these will favour survey designs with parallel transects perpendicular to the shore. It is important that survey vessels adhere closely to such transects as strong tides during particular surveys may otherwise cause deviation from equal coverage probability across the survey area, a crucial assumption of line transect survey design.

Surveying a 4 km buffer around developments has become the norm for offshore renewable energy surveys though there is no strong reasoning behind this particular buffer size, given the considerable travel ranges of most marine mammals and likely spatial extent of some relevant impacts (e.g. noise). Designs with smaller and/or asymmetric buffers are also likely to provide the information required. In this case, a 4 km buffer is a good starting point for the design. Following discussions with the master of the survey vessel *Corystes*, the original design was slightly amended to reflect the need to stay at least 500m offshore to ensure the vessel would be able to safely turn whilst towing a hydrophone array in areas close to the coast and complying with the traffic separation scheme. This required on-effort transects to be curtailed at 900 m from shore.

The distance between successive transects should be kept as large as practically possible, in order to avoid influencing animals in adjacent transects that have not yet been surveyed. By convention, seabird surveys take at least 0.9 km as a minimum distance between transects (Camphuysen *et al* 2004). Although a wider transect separation distance would be better for marine mammals (given the likelihood of them responding to vessel noise at considerable distances), it is not possible to place them significantly further apart without coming into conflict with the requirement for at least 20 transects within the survey area. Therefore, to ensure there are at least 20 transects in the survey area, an inter-transect distance of 1 km was selected.

A significant problem of marine mammal surveys of any kind is the difficulty in obtaining sufficient detections to achieve a statistically robust density estimate (here defined as an estimate that is accurate, with a low variance, or narrow confidence interval surrounding the mean estimate). A high variance will mean low confidence that the resulting density estimate is accurate, therefore a principal element in survey design consists of reducing the risk of high variance in the results.

Due to the generally low densities of marine mammal species, a compromise is generally required between the amount of survey effort needed to achieve robust density estimates (with low confidence intervals), and the effort (i.e. cost) required to gather the data, particularly on sites such as the Fair Head site that are very small relative to typical marine mammal movement patterns. Based on the literature (Buckland *et al*. 2001), a generally acceptable minimum number of detections is 60-80 per species for which density estimates are desired, over the course of the entire survey programme.

Because the density estimation process is based around detections per transect, too few transects in a survey design (among other factors) can also result in a high variance surrounding the resulting density estimates. As variance is driven by inter-transect variability, too few transects may skew the final result. A minimum of 20 transects per survey is generally considered acceptable for line transect surveys, and this has been observed in this survey design. These transects should be as long as can feasibly be surveyed within available daylight hours to increase the likelihood of more detections and thereby the accuracy of the resulting density estimates.

3.2 Transect Placement

A systematic parallel line survey design, using fixed equidistant transects, is a typical approach for surveying offshore renewable energy development areas such as the Fair Head site. In this approach, a series of parallel transects are laid out across the survey site at fixed distances, as per published guidance (Buckland *et al*. 2001). A minimum of 20 transects should be covered in each survey in order to improve the chances of obtaining an adequate variance around any resulting density estimate. At least 10 of these transects should traverse the site and its immediate vicinity (the development site buffered to 1km is approx. 5.1 km long at its greatest extent) in order to ensure the survey results can be taken as representative of the site locality. To ensure both these criteria are adhered to, as well as ensuring that coverage probability will be equal across the survey area, fixed equidistant linear transects are more appropriate than randomly spaced transects.

Potential concerns with linear survey designs include wasted time travelling between transects (i.e. boat movement on the site but with no data collection), as well as the risk of deviation from transects due to strong currents (particularly relevant in areas considered for tidal energy development). Boat movements between transects actually allow surveyors a break from continued observing and may therefore be indirectly beneficial for data collection. Alternative survey designs, based on various versions of zigzag transect placement, were also explored (cf. Buckland *et al*. 2001). Zigzag designs have the potential advantage that no time is lost transiting between consecutive transects, although they are generally more appropriate for larger survey areas. In order to conform to the various criteria outlined above, numerous tests were run in the software program 'Distance' to find a suitable design.

It was relatively straightforward, on the basis of the transect distance criterion, to develop zigzag survey designs containing at least 20 transects overall. However, it became clear that in order to fulfil the additional criterion of at least 10 transects traversing the site, a considerable number of transects would be required, extending the total survey length beyond that generated by other designs. As the site is adjacent to the edge of the survey area (bounded by the coast), the standard procedure of mirroring the survey design on the return leg of the survey could not be counted upon to generate at least 10 such transects, without significantly increasing total amount of effort. Also, with so many transects across a relatively small survey area, the distance between transects became increasingly small, leading to considerable spatial overlap between coverage of consecutive transects near the boundary of the survey area. This repeated coverage of the same area on consecutive transects represented a waste of survey effort. Furthermore, the increasingly tight turns required by these survey designs would likely represent practical difficulties for a vessel in a tidal site towing a hydrophone array. For these reasons, the systematic parallel line survey design is considered more appropriate here, assuming that the survey design takes current direction into account.

A fixed distance parallel survey design was developed that met all the relevant criteria outlined above. On previous surveys of the West of Islay DPME site where transects were deployed perpendicular to the current, there was no indication that efficacy of transect coverage was heavily influenced by tidal currents, suggesting this might also not be a significant problem at the Fair Head site. Survey designs that successfully meet the above criteria lead to a minimum separation between each transect of approximately 500 m, substantially below the acceptable minimum distance. It is proposed that this problem be prevented by surveying alternate transects: first all odd-numbered would be surveyed, then all even-numbered transects would be surveyed, leading to an effective transect separation of 1 km. Furthermore, it is proposed that there be a gap of at least one hour between runs along adjacent transects, to allow for animal redistribution in the event of any disturbance caused by the earlier pass. One way in which this could be achieved would be to survey both odd and even transects in the same direction (i.e. upon completing the odd transects, the survey vessel could return to the beginning before starting to survey the even transects, so that there will be a time gap of several hours between adjacent odd and even transects). Such an approach would also allow for better understanding of the impact of tidal phase on detections, as it is likely to vary appreciably on such timescales.

As discussed earlier, it is important to ensure that sufficient detections are made to achieve robust density estimates with reasonable amounts of variance (Buckland *et al*. 2001). If sample sizes are very small, variance surrounding any density estimate resulting from such a small sample may be extremely large and the resulting estimate will be comparatively valueless in determining site usage. Survey approaches that ensure at least 60-80 detections are recommended for average density estimation (Buckland *et al*. 2001).

On the basis of previous experience at Islay, marine mammal sighting rates at the site were initially expected to be comparatively low. At the Islay site, the most “frequently” sighted species was the harbour porpoise. During 20 monthly surveys over 2 years representing 2,248 km of survey effort, a total of 12 pods containing a total of 18 porpoises were seen. On average, a pod contained 1.5 animals. In contrast, even though densities of most seabird species in Islay survey area were relatively low, the same survey design provided over thousand sightings for one seabird species (common guillemot), and over a hundred sightings each for six other species (fulmar, Manx shearwater, gannet, kittiwake, razorbill and puffin). This would suggest that a (potentially unrealistically) large amount of survey effort might be required to achieve the defined goals of at least 60-80 detections and resulting robust density estimates for the various marine mammal species.

Initial results from surveys undertaken at the Fair Head site suggest, however, that detection rates may be higher than at Islay. At Fair Head, the first 2 visual MMO surveys (July & August 2013) detected the following whilst on transect (Table 2):

Table 2. Summary of survey effort and visual detections of marine mammals recorded on transect during dedicated visual surveys, July-and August 2013.

Species	No. Sightings	No. Individuals	Range of Group Size
Common dolphin	1	2	2
Harbour porpoise	24	47	1-6

A further 11 harbour porpoise, 25 common dolphin and 1 grey seal have also been sighted “off transect”, whilst bottlenose dolphins were also recorded during the October survey (which has not yet been analysed in detail). It is likely that the low sighting rates in the Islay study were at least partially the result of relatively high sea states encountered at these sites, which made it difficult to spot porpoises and other marine mammals. High sea states are expected to be a potential problem in detecting animals at the Fair Head site as well. However, it may be that the Fair Head site turns out to be more heavily used by marine mammals in general, thus allowing for more robust density estimates despite the challenging environmental conditions.

Acoustic detections of porpoises, as recorded by the towed hydrophone array, may be more frequent but can only provide a minimum rather than absolute density estimate (as not all animals vocalise, not all animals are detected, and multiple animals vocalising at the same time cannot be reliably distinguished). At the Islay site, during 20 monthly surveys over 2 years, 41 successful high-quality porpoise detections were made, resulting in an average detection rate of 0.018

detections/km surveyed. Based on initial visual survey results at Fair Head, it is possible that higher acoustic detection rates might be expected than was the case at Islay, although this is highly dependent on various factors such as vocalisation behaviours and hardware. Acoustic surveys can likely provide a greater number of detections than visual surveys for the same amount of effort. However, in addition to the potential problems outlined above, they will not provide any information on non-vocalising animals (including species such as minke whales, seals, and basking sharks) and so acoustic techniques are most relevant as an additional source of data for echolocating odontocetes such as harbour porpoise (see Section 3.14).

Bathymetry of the Fair Head site survey area typically ranges between 30-50 m, with some deeper depressions (occasionally down to <100 m). Within the wider 4 km buffer surrounding the proposed development site, the main bathymetric features include the channel between Fair Head and Rathlin Island, as well as deeper water further offshore. Previous acoustic surveys off Islay repeatedly identified a concentration of acoustic porpoise detections near an underwater ridge immediately south of the proposed development site there. No such feature is immediately apparent, suggesting that, at the Fair Head site, transects are unlikely to be accidentally placed along specific bathymetric features that might attract animals in a similar way.

For the ten or so species of seabirds for which at least low densities are expected to use the Fair Head site (see Table 1) it is concluded that the proposed visual surveys are likely to provide robust absolute density estimates. For marine mammals and basking sharks it is concluded that, as is generally the case for offshore development sites, visual and acoustic surveys as currently proposed may not be able to provide robust *absolute* density estimates for these species within the comparatively small footprint of the Fair Head survey area, on the basis of the various survey criteria and assumptions discussed above. Nevertheless, such surveys will provide vital information on variation in *relative* densities (on seasonal and interannual scales) and distributions of different species across the survey area and their relevance in impact assessment. Moreover, concurrent observations of marine mammals and seabirds will allow an evaluation of multispecies habitat usage in the area, which will also be relevant to impact assessment. A provisional design that is practical for surveying marine mammals while meeting all the required and desirable features for surveying seabirds is illustrated in Figure 1. This design has been developed through discussions between researchers at SRSL, NRP Ltd and CREEM (Centre for Research into Environmental and Ecological Modelling), and is considered as robust as any practical survey approach for the site.

The design has 22 transects varying in length between 5.4 and 7.4 km. Transect lengths are limited by the 4-km buffer around the site and indentations of the coastline. Transect are spaced 0.5 km apart. To prevent the violation of the minimum transect guideline, alternate transect lines would be surveyed successively as described earlier. The total length of the transect lines is 134 km. In addition, if sailing alternate transects, the transect tails amount to a further 20 km. It will be desirable to travel back to the other end of the survey area (i.e. that day's start location) after completion of the first series of transect (i.e. the odd or even series), which would add a further 10km to the survey length and approximately half an hour to the survey time. The entire area would then be surveyed for the second time, but under a different tidal regime than that which was in place during the first half of the survey, whilst maintaining a constant time difference between survey passes along consecutive odd and even transects. Thus in total the survey design entails 164 km of boat distance. At a speed of 10 knots this would take 8.8 hours to complete. At a speed of 9 knots it would take 9.8 hours. Thus the design is achievable in a single day except in mid-winter months when daylight hours will be reduced to around 7-8 hours. It is proposed that mid-winter surveys are based on a reduced design of 18 transects, missing out transects 2, 4, 20 and 22 to make the survey more achievable in daylight hours (133 km in total), accepting that this may negatively impact already low expected marine mammal sighting rates in winter. Coordinates for the start and end points identified in Figure 1 are included as Appendix 2 at the end of this document.

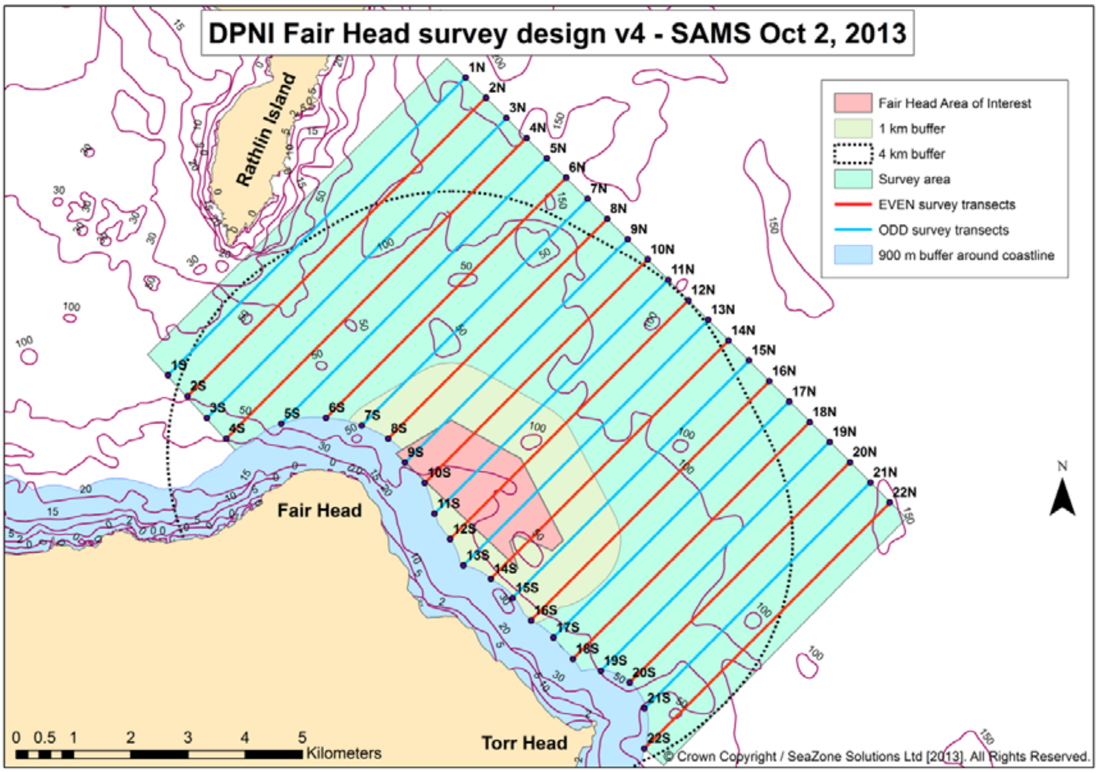

Figure 1. Proposed visual/acoustic survey design for Fair Head site.

It is worth noting that the present survey design also covers a substantial portion of the waters surrounding the adjacent Torr Head Site of Interest (Figure 2). This could be relevant to the assessment of cumulative impacts from both development sites, whereby establishing the relative contribution to key impacts (such as collision to marine mammals or with diving seabirds) will be necessary; this requires comparability between the data sets (and subsequent impact assessment).

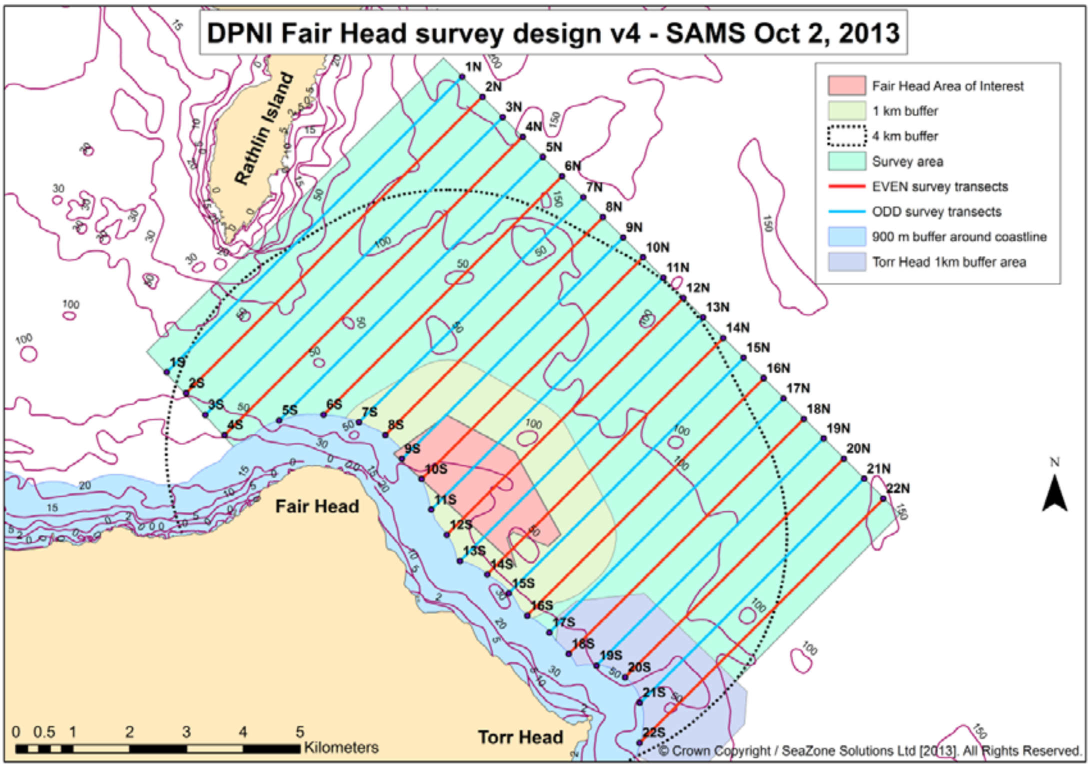

Figure 2. Proposed visual/acoustic survey design for Fair Head site, including the proposed Torr Head Site of Interest.

4. SHORE-BASED OBSERVATION OPPORTUNITIES

To be successful, shore-based observations to record seabirds or marine mammals using the Fair Head area of interest would need to be undertaken from shore vantage points (VPs) that are sufficiently close by for animals to be detected. Vantage point studies of seabirds and marine mammals undertaken by NRP in Scotland show that it is feasible to detect species up to at least 2 km away. However, unless sea conditions are very calm, for less conspicuous species such as auks and harbour porpoise, beyond approximatley 1 km there is likely to be a fall off in detectability with increasing distance. Given that flat calm conditions (sea state 0) will occur infrequently, it is likely that shore-based observations would also need to target periods of sea state 1 to 3. For auk species, at least, a distance of aproximatley 1.5 km is likely to represent the effective upper practical limit for observations. The development search area's inshore boundary lies between 0.9 and 1.6 km from the coast and the centre of the area is approximately 2 km from the nearest coast. It is clear therefore that there are only significant practical limitations for undertaking shore-based observations, both in terms suitable shore vantage points and suitable sea conditions.

Three candidate vantage point locations have been identified as being potentially suitable for vantage point observations of seabirds or marine mammals (Figure 3, Photos 1 to 3). These locations differ in their characteristics (Table 3) and each has advantages and disadvantages for observations compared to the others. Candidate 2, near the base of the Fair Head cliffs is considered to be the best option though it is intended to confirm this empirically, during the pilot survey.

Table 3. Characteristics of candidate vantage points.

	Candidate 1	Candidate 2	Candidate 3
Name	Fair Head top	Fair Head base	Murlough Bay
Grid ref (approx.)	318600/443300	318750/443219	319500/442340

Altitude	190 m	approx. 48 m	approx. 25 m
Distance from nearest road	1 km	1 km	0.1 km
View direction to centre search area	65 degrees	60 degrees	30 degrees
Distance to search area boundary	1.05 km	1.05 km	1.4 km
Distance to search area centre	2.2 km	2.1 km	2.0 km
Shelter	Very exposed to all directions	Sheltered from NW through W to S	Sheltered from NW through W to SE

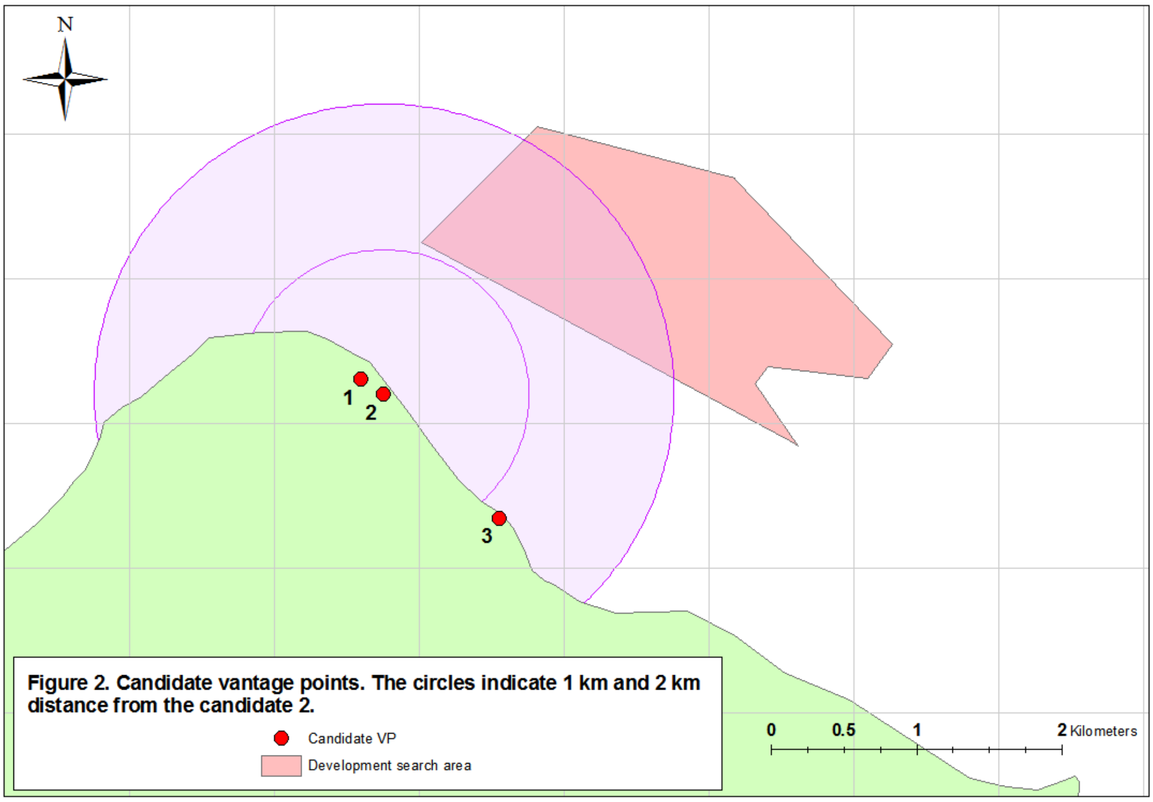

Figure 3. Candidate vantage points as identified by NRP (see text, Table 3 for details). Circles indicate 1 km and 2 km distances from the candidate point 2.

Photo 1. Fair Head from the south-west showing the 196m high cliffs.

Photo 2. Aerial view of Fair Head from the north-west.

Photo 3. Satellite photo showing the location of vantage point candidate 2 near the base of the Fair Head Cliff

5. SEABIRD SURVEY AIMS AND METHODS

5.1 Visual boat-based survey aims

The broad aim of the boat-based survey work is to collect the information required to characterise the importance the development search area and a surrounding buffer for seabirds to the level of detail needed for impact assessment.

Specific aims are to establish which species of seabird regularly occur in the survey area and for each species to:

- estimate abundance with confidence limits;
- map distribution across survey area;
- determine gross behaviour (i.e., flying or sitting on the sea); and,
- examine how the above parameters vary seasonally.

In order to estimate abundance with confidence limits it is also a specific aim that the data collected should be in a format suitable for Distance analyses (Buckland *et al*. 2001).

Seabirds will be surveyed using the standard European Seabirds at Sea (ESAS) survey method. This method is recommended for surveys of offshore tidal energy sites in the SNH draft survey guidelines (Jackson and Whitfield 2011) and for surveys of offshore windfarms by COWRIE (Camphuysen *et al*. 2004). Details of the ESAS method are described in detail in Camphuysen *et al*. (2004).

The essential details of the ESAS method are as follows. A team of two accredited ESAS surveyors observe from one side of the survey vessel and record all birds (and other wildlife) up to 300m away. Surveyors record species, plumage, age and whether the bird is flying or sitting on the sea together with information on weather and sea conditions. Other information on behaviour is also recorded if apparent. Birds sitting on the sea are assigned to one of four distance bands so that the data are suitable for Distance sampling analyses (Buckland *et al*. 2001). All flying birds within 300m of the boat are recorded and each determined as being 'in transect' or not according to whether they are inside a 300m x 300m box at the time of regular snapshots (time interval of snapshots depends on boat speed, at 10 knots the interval is one minute).

Surveys will be undertaken from a vessel meeting the requirements for ESAS (Webb & Durink 1992). Foremost amongst the vessel specifications are an adequately stable elevated observation platform giving surveyors an eye height of at least 5m above sea level and with space for several seated surveyors. The vessel also needs to be capable of maintaining a constant speed of at least 8 knots, including, ideally, when travelling against tidal currents of the strength occurring in the survey area. The survey vessel will be shared with the marine mammal surveyors, who will operate as an independent team.

It is proposed that twenty four surveys be undertaken over two years, at approximately monthly intervals.

5.2 The value of shore-based observations of seabirds

On the basis of results of previous survey work in the area (Kober *et al*. 2010, Mitchell *et al*. 2004), it is expected that the Fair Head Tidal Array search area is regularly used by moderate or high densities of common guillemot, razorbill and black guillemot throughout the year (but perhaps with a period of lower densities in the autumn) and by moderate densities of puffin. There are large numbers of guillemots and razorbills, and smaller numbers of puffin and black guillemot, breeding on Rathlin Island. Common guillemot and razorbill are qualifying features of the Rathlin Island SPA. There are also small numbers of guillemot and razorbill breeding closer to the search area on the cliffs between Fair Head and Torr Head. If these auk species are actively diving in the search area then there could be potential for fatal collisions with tidal energy converters (TECs). In a recent review of seabird vulnerability to the impacts of tidal arrays, common guillemot, black guillemot and razorbill were rated as having high vulnerability and puffin as moderate vulnerability (Furness *et al*. 2012). The relatively high vulnerability ratings for these four species largely stems from the apparent potential for impacts from collision.

There is currently uncertainty regarding whether tidal stream devices pose real collision risks to diving birds (as opposed to a perceived theoretical risk), however, should they cause significant mortality this could have serious implications for the viability of diving bird populations. Auks are relatively long-lived species with delayed maturity and high annual survival rates, thus even a relatively small amount of additional mortality could potentially affect a population's viability. Methods to estimate underwater collision risk are being developed and are likely to be essentially similar in approach to the methods used for estimating the collision risk posed by wind turbines to flying birds. A key parameter in such marine collision risk models will be estimates of the number of dive events per unit time (season or year) in the area where TECs are located.

The program of boat-based ESAS surveys will obtain year-round data to estimate the numbers of theses auk species (and all other seabird species) using the search area. However, the ESAS survey method does not observe individual birds on the sea for long enough to reliably ascertain if they are actively diving or merely loafing, and in any case the approach of the survey vessel could affect their behaviour. Therefore, the ESAS data alone do not provide all the information required for collision rate modelling. It is considered likely that the ESAS data can be usefully complemented by focal watches of individual auks and that this can be practically achieved by shore-based observations. The field work and approximate effort required to do this are described below. In the absence of complementary focal watch data on behaviour (due to the pilot study which concluded that behavioural observations were unrealistic at such a distance offshore), the assessment of collision impacts would need to use generic data on auk species diving behaviour and make cautious assumptions about what proportion of birds present are diving.

Auks typically show bouts of feeding activity lasting for up an hour or so in which they make a series of feeding dives in relatively quick succession (e.g., Evans *et al.* 2013). The bouts of feeding activity are interspersed with bouts of other activity such loafing (resting and preening), commuting flight and time spent on land at the colony. It is straightforward to determine by simple observation of individual birds (i.e., focal watches) whether or not they are engaged in a bout of feeding or other activity. NRP has undertaken focal watches of auks and other diving birds for a number of projects in Scotland and found this to be a good way of collecting basic data on behaviour, however there are various practical constraints.

Focal watch information on auk behaviour from the breeding season will be more valuable for the project because of the expected high connectivity to SPAs at this time of year (e.g., on the basis of foraging distances in Thaxter *et al*. 2013), especially with Rathlin Island SPA. With the exception of black guillemot which is a sedentary species, in the autumn and winter the auks present are likely to originate from breeding colonies spread over a wide geographic area, including from overseas colonies such as those in Iceland and Scandinavia. For this reason it may be decided that focal watches are not required outside the breeding season. The value of focal watches during the autumn and winter will depend on how many auks are present. Focal watches during the autumn and winter would be worthwhile for the project only if relatively high densities numbers (say, at least approximately 5 birds per km^2) of auks are present in the area of interest, as only in these circumstances is it plausible that the potential for collision strikes could lead to significant impacts on a population’s mortality rate. The encounter rates for auk species from the monthly boat-based surveys will be used as the basis for deciding if the densities of auks present merits undertaking focal watches in autumn and winter months.

5.2.1 Shore-based seabird focal watch aims

The primary aim of the shore-based surveys will be to obtain representative information on the relative proportions of auk species present on the sea that are actively diving versus loafing. Secondary aims will be to collect information on auk dive duration and the timing of diving behaviour relative to tidal cycle.

Summary of aims:

- Quantify the relative amounts of loafing and diving behaviour;
- Obtain information on dive duration (from this approximate dive depth can be inferred);
- Determine if there is a relationship between diving behaviour and tidal cycle (current speed;

Such shore-based surveys could also obtain additional information on cetaceans, as any cetacean species seen during seabird focal-watch studies would be recorded. The same observer could collect information on both seabirds and marine mammals, for example alternated bouts of survey activity aimed at each group. This approach is detailed further in Section 6.1.2.

5.2.2 Shore-based seabird focal watch method

The focal watch method is simple. An elevated vantage point is selected overlooking the area of interest. The observer chooses an individual of a target species sitting on the water 'at random', notes its species, bearing and estimated distance away, and then watches the bird constantly for a fixed period through a spotting scope. During the period of observation the behaviour of the bird is noted, in particular whether or not it dives and if so at what time. Where possible dive duration is also recorded, i.e. the observer also records when the bird surfaces if this can be unambiguously detected. Having completed a focal watch on one individual bird, the observer then selects another at random for the next focal watch.

A bird's location on the sea can be determined from its angle of declination (measured using a ranging stick or more sophisticated equipment such as a digital clinometer) and compass bearing from the VP. Studies by NRP in Orkney have concluded that a watch period of two minutes is optimum for accurately classifying whether the behaviour bout of the bird under observation is either diving or loafing. The results on time intervals between dives from electronic tagging studies (e.g., Evans *et al.* 2013) also indicate that a two-minute watch period should result in a high rate of correct bout classification.

A practical consideration that will affect the success of focal watches is the density of birds of target species present. Ideally target birds would be restricted to those within the area of interest for development, yet the extent to which this area overlaps with the area in which birds are close enough to the VP to be observed is expected to be quite small. For example, the portion of the development search area that is <1.5 km from the proposed VP is only about 0.5 km^2 . Roughly speaking, unless auk densities exceed several birds per km^2 at the time of a focal watch session then there will be too few birds present to give a reasonable sample size.

A further practical consideration will be sea conditions. Vantage point studies undertaken by NRP in Scotland suggest that focal watches at Fair Head will be practical only in relatively calm sea conditions. It is proposed that focal watches would only be undertaken in sea state conditions of 0 to 3 and a swell height of <1m.

The amount of effort required for the shore-based surveys will depend on the detail of the questions to be addressed and the density of birds present. In good observations conditions and provided there are sufficient birds present. Using a two-minute focal watch period it is theoretically possible to classify around 25 individual birds as diving or loafing in a one hour observation session. To give a high degree of statistical confidence in the results, several hundred individuals would ideally need to be classified. Sampling would aim to be representative with sufficient effort being given to different times of day, different states of the tide and different times of year.

Provided there are sufficient densities of birds present and sea conditions are suitable, it is considered likely that approximately two days spent per month undertaking focal watches is likely to give sufficient data on auk diving behaviour. This can probably be achieved by a lone fieldworker. This approximate figure is indicative only; a full assessment of the level of effort should be undertaken once the results of the proposed pilot study have been evaluated.

5.2.3 Focal watch pilot study

The site-specific practical limitations of undertaking observations from Fair Head have yet to be determined empirically. Given the relatively large distance between the development search area and the candidate VPs, and the relatively high altitude of the candidate VP at Fair Head, it is proposed that a small pilot study is undertaken to determine how best to take account of these limitations and give confidence that the proposed focal watch study can practically be achieved. The pilot study would evaluate both candidate VPs by attemping to undertake focal-watches on birds at a range of distances and sea conditions. Provided there are reasonable densities of auks present and conditions are adequately calm, a two-day pilot project is anticipated to be adequate to answer questions about practical constraints. It is intended that the pilot survey is undertaken before the 2014 breeding season.

On the basis of experience elsewhere, the candidate vantage points at Fair Head are further away (at least 1 km) from the development search area than is considered preferrable for observations of auks (ideally they would be <1 km away). Because of this it is likely that observation at Fair Head will be practical only in relatively calm sea conditions, probably sea states of 0 to 3 and a swell height of <1m height. The candidate VPs are located approximatley to the south west of the development search area, which is ideal for observations at most times of day as the sun will be behind the observer and thus eliminating the problem of sun glare. The candidate VPs also have good elevation (extremely so in the case of Fair Head itself) which will bring advantages in terms of reducing the likelihood that a focal bird will be obscured by swell.

6 MARINE MAMMAL VISUAL SURVEY METHODS

6.1 Boat-based visual survey

As explained previously in Section 5, the broad aim of the boat-based survey work is to collect the information required to characterise the importance of the development search area and a surrounding buffer for marine mammals and other marine megafauna (e.g. basking sharks and marine turtles) to the level of detail needed for impact assessment where possible. Specific aims of the visual marine mammal survey are:

- to establish which species regularly occur in the survey area,
- to map distribution across survey area;

- to estimate abundance with confidence limits for those species that are recorded sufficiently frequently;
- to assess temporal variability at seasonal scales.

In order to estimate abundance with confidence limits, the data collected should be in a format suitable for Distance analyses (Buckland *et al*. 2001). Survey design approaches to ensure this is the case have been discussed in detail in Section 3. Surveys will be conducted from a vessel conforming to ESAS requirements (Camphuysen *et al*. 2004) by a minimum of two (2) trained marine mammal observers (who must be sufficiently experienced) standing at a sufficient height (>5 m) above the sea surface with an unobstructed view ahead and to port / starboard to at least 90° abeam. The vessel will be travelling at an average speed of 9-10 knots (approximately 16-19 km per hour).

Observers will record sightings of marine mammals, basking sharks and marine turtles while travelling on the transects laid out in Figure 2. They will also record data on environmental conditions at the beginning of each transect and if conditions change while on transect. Environmental conditions to record include the following:

- Sea state (Beaufort; see Table 4)
- Swell (direction, height)
- Sun glare (Angles from L to R, intensity)
- Weather (Overcast, sun, drizzle/fog, rain)
- Unanticipated course changes

Table 4. Beaufort sea states using the standard and working definitions used during the surveys.

Beaufort Sea State	Standard definition	Working definition
0	Flat	Glassy mirror-like
0.5	-	Faintest ripples
1.0	Ripples without crests	Scale ripples
1.5	-	Glassy wavelets
2.0	Small wavelets. Crests of glassy appearance, not breaking	Small wavelets
2.5	-	No white or large wavelets
3.0	Large wavelets. Crests begin to break; scattered whitecaps	Occasional whitecaps
3.5	-	Persistent whitecaps
4.0	Small waves with breaking crests. Fairly frequent white horses	Numerous whitecaps
5.0	Moderate waves of some length. Many white horses. Small amounts of spray	Many whitecaps & some spray
6.0	Long waves begin to form. White foam crests are very frequent. Some airborne spray is present	Too rough to see animals unless leaping or in large groups.

Based on previous experience surveying west of Islay, it is recommended to also record a Sightability score of whether animals would be observable if present under current conditions, based on the observer's experience (Table 5). This will subsequently allow data to be reviewed in a more straightforward manner.

Table 5. The marine vertebrate sightability scale used. The experienced observers judged whether animals were likely to be seen if present by merging factors such as Beaufort sea state, swell height, fog and sun glare into five broad bins.

Sightability	Description
1	Excellent

2	Good
3	Moderate
4	Poor
5	Very poor

Sea state is typically a direct correlate of wind conditions and fetch but is also heavily influenced by the relative direction of the tide versus wind in tidal areas. Accordingly, tidal-energy sites frequency exhibit sea states substantially rougher than prevailing winds would suggest. As sea state has a significant influence on sightability of marine mammals and other species, it may be necessary to undertake surveys around periods of neap tides, as weather windows permit. Visual surveys should be timed to take advantage of weather windows where the sea state is as low as possible (i.e. at or below Beaufort sea state 3) and to minimise swell conditions. The visual survey should be curtailed if conditions become unfavourable to visual surveying, e.g. when sea states exceed 3, heavy rain or fogbanks develop, etc.

Although seabird and marine mammal observations can be carried out from the same vessel, it is important that the marine mammal observations are carried out by a separate team of observers distinct and isolated from the seabird observers (MacLeod *et al*. 2011). In particular, marine mammal observers should not make use of distance bands as prescribed by the ESAS methodology, but should attempt to determine, as accurately as possible, the linear distance from the vessel to the animal and the angle of a straight line to the animal, relative to the trackline. These two parameters, together with a timestamped GPS location of the vessel at the time the detection was made, will subsequently allow the location of the animal to be mapped and the perpendicular distance of the animal to the trackline to be calculated, a crucial step in Distance analysis (Buckland *et al*. 2001). It is therefore important to record positions, distances and angles as accurately as possible. For this purpose, GPS units, angle boards and reticle binoculars are recommended.

For each sighting, observers should record the following points:

- Species
- Number of animals
- Presence and number of juveniles vs. adults
- Distance to survey platform
- Angle from bow
- Magnetic compass angle to observer, if possible

Observers will record sightings and parameters described above in a standardised format (such as IWDG) that will meet the analytical needs. IWDG format can be reported in JNCC format if required, but allows for more detailed environmental observations to be recorded which is appropriate for the dynamic conditions experiences in tidal sites where conditions can change significantly over the course of a transect. Based on previous experience in surveying west of Islay, it is proposed that a survey log be kept using freely available software (Logger, IFAW), which should be used to provide a real-time record of the survey. This software can be run on a laptop such as the one involved in running the passive acoustic monitoring (PAM) towed array, which should then be set up to receive input from the ship's GPS unit to ascertain its position. Observers can use simple hand-held, portable, two-way radio transceivers to report sightings and environmental

conditions to the PAM operator (see Section 7.1.1) who can subsequently enter data directly into Logger. This will improve data storage and security.
Surveys will be conducted for twenty four months, at approximately monthly intervals wherever possible.

6.2 Shore-based observations

Protocols for studying the occurrence of large marine vertebrates (cetaceans , pinnipeds, marine turtles and basking sharks) around areas suitable for tidal-energy extraction are currently poorly developed and have not yet reached a level that could be considered standardised. Existing surveys have been primarily tailored to suit the specifics of the area of interest. For example, the leading edge developments of Strangford Lough (Marine Current Turbines) and the Fall of Warness (European Marine Energy Centre) have independently developed shore-based watch routines to record marine mammals surfacing in the areas of key interest (summarised in ICES WGMME 2011). This approach is dependent on the presence of nearby land vantage points. As discussed in Section 4, the present site, centered at approximately 2 km offshore from Fair Head, is relatively distant for undertaking such observations in anything but calm sea conditions. However, dedicated shore-based visual surveys from atop Fair Head, using binoculars, will provide additional information on small-scale variation in marine mammal distribution, particularly in waters closer to shore where the larger vessel cannot safely navigate (Figure 1).

This survey work can be combined with seabird survey operations from the same location, and can be undertaken by the same observer whenever conditions allow. Surveys do not have to be scheduled monthly, but overlap in observations would provide additional valuable information and should be targeted. These shore-based observations will be particularly helpful in establishing an independent index of density for different species of marine mammals in inshore waters. Assuming animals are approximately uniformly distributed across the survey area, such an index offers a way to independently assess the efficacy of the boat-based visual survey. Shore-based observations therefore provide a different method to clarify how marine mammals, turtles, and basking sharks make use of the area in the vicinity of the proposed development site. The current proposal assumes that a single observer undertaking the focal watches described in Section 5.2.1 would record any marine mammals seen from the Fair Head vantage point in the coastal area between the shore and the development site. Observations could take place at set intervals during seabird focal watches for a predefined period (for example 30 minutes). The observer’s particular focus would be to detect bottlenose dolphins, which are listed on Annex II of the Habitats Directive and which are known to have a predominantly coastal distribution (Cheney *et al*. 2013). These observations can be complemented by routine ongoing DoE Marine Division (Previously NIEA) marine mammal observations from Torr Head (undertaken using IWDG monitoring protocols and infrastructure). It is proposed to test this approach during the aforementioned focal watch pilot study for diving alcid seabirds (Section 5.2.3).

7 MARINE MAMMAL ACOUSTIC SURVEY METHODS

7.1 Towed hydrophone array (PAM)

While surveys will be targeted to coincide with sea conditions suitable for visual sightings, this may not always be possible. In addition to the visual observers, the survey vessel will therefore be towing a hydrophone array (with a minimum of 3

elements) designed to detect, and where possible, localise the vocalisations of echolocating odontocete cetaceans (dolphins, porpoises and other toothed whales). This passive acoustic monitoring (PAM) system provides a second means of detecting these animals and will also improve odontocete detection probabilities in sea states exceeding Beaufort 3 (up to around 6). Equipment set-up and survey will be conducted by a qualified and trained PAM operator as part of each survey, and data will be recorded for *post-hoc* analysis and review where required. The survey vessel must therefore be able to provide sheltered accommodation for the PAM operator as well as aft access for deployment and retrieval of the hydrophone array.
The towed array will be configured in such a way as to have the capacity for localising echolocating odontocetes. Assuming individual hydrophone elements are correctly located relative to each other (25 cm is standard for porpoise detections), an array (consisting of 2 wideband high-frequency) elements and a minimum of 1 additional element to allow low to mid frequency detections to be made will be able to localise echolocating odontocetes, with a Left/Right ambiguity. Although perpendicular distance to the trackline can be established, it is not possible to determine whether animals are to the left, to the right or indeed directly below the hydrophone array with this configuration and additional hydrophone elements would be required to resolve this uncertainty. This would also add cost in terms of hydrophone complexity and additional analytical effort, and is not considered to offer a proportionate benefit. A towed array should be equipped with a depth sensor to ensure that the unit remains at constant depth throughout the survey.

A standard towed hydrophone array of the type described above should have the capacity to detect and locate almost all echolocating odontocete cetaceans. The exception would be the sperm whale, which would be detectable but not locatable due to the particular characteristics of its echolocation signals. Baleen whale vocalisations occur at lower frequencies and require the lower-frequency element to offer detection, and would require another to allow localisation in a manner similar to echolocating odontocetes. Similar considerations of cost and complexity apply.

Survey vessel movement will be kept as constant as possible while towing the hydrophone array to ensure it remains straight and at constant depth, and this is achieved through the rigorous requirements of the ESAS survey protocol. In order to obtain the cleanest recordings for further analysis, it is important to turn off the survey vessel's echosounder during the survey (where the navigational risk is acceptable). Assuming the PAM operator is suitably skilled, s/he can participate in ongoing visual marine mammal surveys in an attempt to rotate observers and reduce observer fatigue. Visual observers could then take the place of the PAM operator in order to record sightings.

Finally, it is important to reiterate that PAM can only provide a minimum assessment of animal abundance and density, even if sufficient data are collected. This is because 1) not all animals may vocalise, 2) multiple animals vocalising as a group may be difficult to identify as individuals, 3) vocalising animals may be oriented away from the hydrophone array, or 4) animals are too distant to be detected acoustically. In addition, numerous other species (including basking sharks and marine turtles) are not known to vocalise and thus cannot be detected by this method. PAM does, however, offer a better chance of detection for some species whose behaviour is more cryptic and in conditions when visual observations are compromised, though the likelihood of encounter with these less frequent visitors is expected to be low.

7.2 Moored passive acoustic detectors (C-PODs)

The marine mammal monitoring plan for the proposed Fair Head tidal energy site consists of several elements, including a regular series of ship-based visual and passive acoustic (towed hydrophone array) surveys, a land-based visual observation programme and the deployment of moored passive acoustic porpoise detectors (C-PODs; Chelonia Inc. 2012). These C-PODs detect and log acoustic echolocation signals, or click trains, of odontocete cetaceans, and are particularly sensitive to the click trains of harbour porpoise (*Phocoena phocoena*). The devices (approx. 80 cm long) can be deployed for up to 3 months (on 10x 1.5V D-cell alkaline batteries), thereby providing continuous omnidirectional high-resolution temporal coverage at a particular location. These devices provide a detailed record of porpoise presence over time that can inform how presence varies according to different temporal cycles, notably the day-night cycle, the ebb-flood tidal cycle and the spring-neap tidal cycle. Furthermore, they provide detailed information on encounter durations and their data can be used to indicate porpoise foraging activity. This provides an important complement to results from ship-based surveys, which are essentially “snapshot” observations across a wider area.

Although C-POD data, by themselves, cannot be used to estimate absolute densities of porpoises (not all animals vocalise constantly, not all are facing towards the detector when they do vocalise, and it is impossible to identify multiple animals vocalising concurrently) and coverage around a mooring is spatially limited (a few 100 m for porpoise clicks, up to 1 km for dolphin clicks), they do provide a long-term dataset of habitat usage that is impossible to obtain by other means (visual observations are not possible at night or in poor weather, and survey vessels only provide a snapshot). Deployment of such devices therefore is a key element of the Fair Head survey strategy.

C-PODs need to be recovered in order to retrieve the data, but can then be immediately re-deployed following battery replacement. Data analysis is initially undertaken by the software package *POD.exe*, which also allows data to be exported to other formats for further analysis. C-POD detection ranges vary depending on ambient sound levels (which can be driven by tidal currents) and inter-device variability. Detection ranges of several hundred metres for porpoises and ~ 1 km for dolphins have been reported in the scientific literature when using the T-POD predecessor unit (Kyhn *et al*. 2008, 2012). The difference in distance is due to the different features of porpoise and dolphin echolocation. C-PODs cost approximately £3,000 per unit (Chelonia Inc. 2012).

Two C-POD units will be available for use at the Fair Head site. A greater number of C-PODS would clearly increase the amount of data that would be gathered but this comes with significant cost and therefore two C-PODs should allow continuous monitoring at one location in the centre of the site. There are two potential monitoring strategies: Both devices could be deployed on a single mooring to ensure redundancy as well as guarding against inter-device variability in sensitivity. During each service iteration (every 2-3 months), both C-PODs would be serviced and redeployed. Alternatively, one C-POD could be rotated with the other in a single instrument mooring strategy (after initial cross calibration of instruments), thereby achieving continued coverage without risking both devices at once (given that loss of the C-POD caused by mooring failure, displacement etc.

would mean loss of the data as well). Mooring design will be undertaken using experience of SAMS/SRSL from Scottish deployments, combined with local operational design considerations required at the proposed development site. It is likely that recovery of the C-POD(s) would be effected by the use of acoustic releases as part of a larger mooring structure containing several contingency options to increase the chance of effective recovery.

The approximate centre (and potential C-POD mooring location) of the proposed development site was located at 55.231085°N, 6.105255°W (Figure 3). At this location bathymetry appears relatively smooth, facilitating deployment/retrieval procedures. As Figure 3 indicates, the approximate detection range of ~300m only allows a C-POD at this location to cover a limited part of the area of interest. Given the propensity of harbour porpoises to travel, however, it is expected that this device could provide a reliable measure of porpoise presence and relative abundance over time that is broadly representative of the area as a whole. As seen in Figure 3, the potential C-POD mooring location is between two vessel-based survey transect lines (#11 and 12).

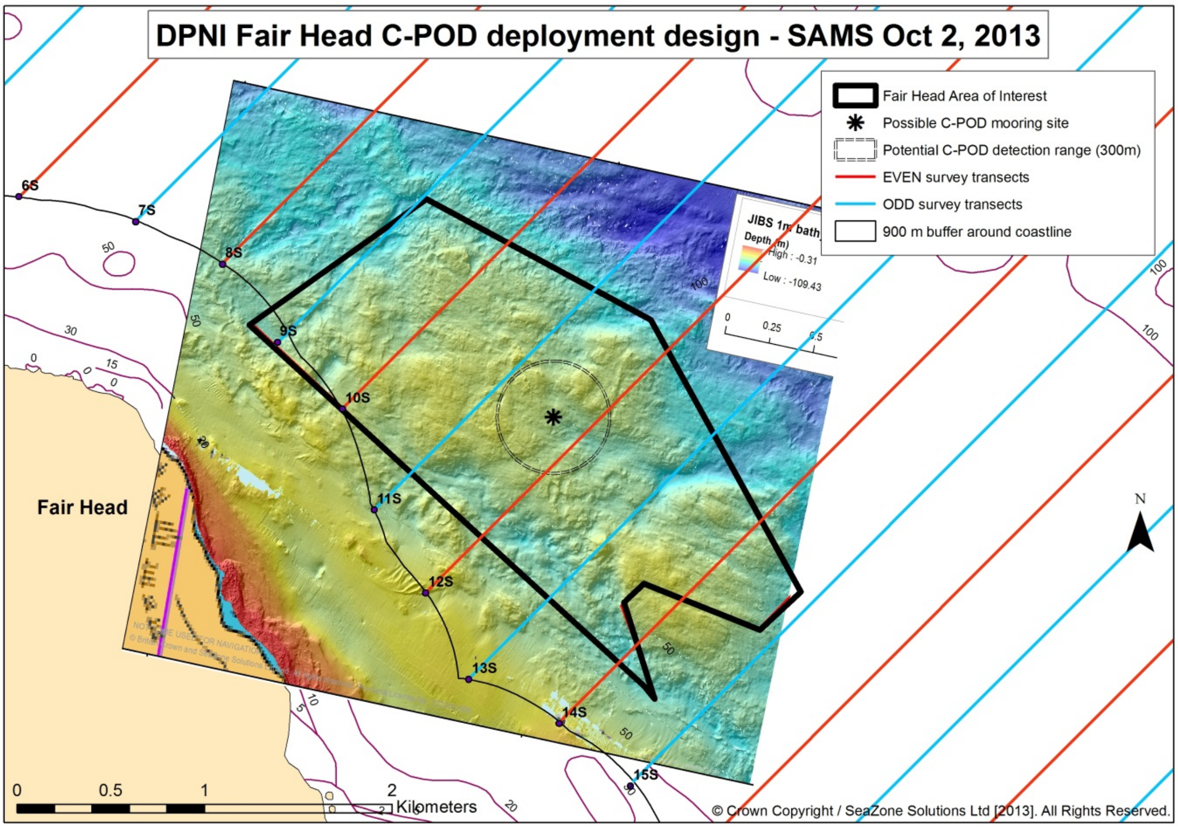

Figure 3. A potential mooring location for C-POD deployment within the Fair Head Area of Interest.

It is important to note that moored C-POD data cannot themselves be used to quantitatively calibrate the results from the visual/acoustic surveys. Because C-PODs (as well as the towed acoustic array) only record vocalising animals, they can only be used to infer presence rather than absence (silent animals would not be detected). As the echolocation beam of a harbour porpoise is relatively narrow, animals that faced away from the detector would also remain undetected; also, multiple animals vocalising at the same time cannot be individually identified. Because C-PODs, as solitary omnidirectional recorders, cannot observe the distance from echolocating porpoises, and because the ranges within which C-

PODs can detect animals are likely to vary across tidal cycles in sites such as Fair Head due to noise interference, their data cannot be used to estimate absolute densities. Vessel-based surveys and C-PODs offer different, yet complementary means of studying the presence and relative abundance of echolocating odontocete cetaceans, one focussing on spatial and the other on temporal variability. The C-POD monitoring approach described here offers the minimum requirement for continuity and redundancy.

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SUPPLEMENT 1: COORDINATES OF NORTH/SOUTH TURNING POINTS OF SURVEY TRANSECTS

Point label (cf. Figure 1)	Latitude (decimal degrees)	Longitude (decimal degrees)
1S	55.23683	-6.19916
1N	55.2919	-6.13645
2S	55.2343	-6.1926
2N	55.28953	-6.12966
3S	55.23167	-6.18601
3N	55.28715	-6.12286
4S	55.22925	-6.17949
4N	55.2848	-6.11615
5S	55.23334	-6.16545
5N	55.28244	-6.10945
6S	55.23574	-6.15365
6N	55.28018	-6.10302
7S	55.2358	-6.14351
7N	55.27768	-6.09587
8S	55.23473	-6.13552
8N	55.27533	-6.08931
9S	55.23169	-6.12952
9N	55.27291	-6.08249
10S	55.22928	-6.12289
10N	55.27057	-6.07584
11S	55.22495	-6.11837
11N	55.26815	-6.06904
12S	55.22165	-6.11259
12N	55.26577	-6.06234
13S	55.2181	-6.1074
13N	55.26347	-6.05575
14S	55.21699	-6.09911
14N	55.26101	-6.04896
15S	55.21484	-6.09202
15N	55.2587	-6.04222
16S	55.21209	-6.08563
16N	55.25626	-6.03545
17S	55.21025	-6.07855
17N	55.25384	-6.02877
18S	55.20767	-6.07196
18N	55.25141	-6.02195
19S	55.20683	-6.06366
19N	55.24911	-6.01536
20S	55.20601	-6.05516
20N	55.24673	-6.0086
21S	55.20263	-6.04957
21N	55.24436	-6.00183
22S	55.19653	-6.0472
22N	55.24198	-5.99536

1.