Torr Head Tidal Energy Array EIA

Non Technical Summary (NTS)

April 2015

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1 INTRODUCTION

1.1 Introduction to Tidal Ventures Limited

This is a Non-Technical Summary (NTS) of the Environmental Statement (ES) for the offshore components of the Torr Head Tidal Energy Array ("the Project") proposed by Tidal Ventures Limited (TVL). The purpose of this document is to provide an overview of the key findings of the Environmental Impact Assessment (EIA) of the offshore Project undertaken by independent energy and environmental consultants Xodus Group.

1.2 Tidal Ventures Limited

The TVL Project at Torr Head on the north coast of County Antrim presents an excellent opportunity for Northern Ireland to be a world leader in the development of emerging, safe, sustainable and renewable form of electricity generation from the exceptional tidal resource that is located in the North Channel.

The development of the Torr Head Tidal Energy Array Project will entail an investment of hundreds of millions of pounds, a significant portion of which will benefit the local and regional economy. TVL is working with local businesses to ensure that they are in a position to take advantage of this opportunity as far as possible.

NI Government Strategic Energy Policy, as set out in the Strategic Energy Framework 2010, is to achieve 40% renewable electricity in the supplied energy mix by 2020. The Project will make a significant contribution to this goal.

TVL was set up in 2010 as a joint venture between the wind energy assets business of Bord Gáis Energy, now Brookfield Renewable Energy Group and OpenHydro Technology Ltd. In October 2012, TVL was awarded an Agreement for Lease (AfL) from The Crown Estate (TCE) to investigate the feasibility of developing a commercial scale 100 MW tidal energy array in the waters offshore of Torr Head on the north coast of County Antrim in Northern Ireland. The award forms part of Northern Ireland's Offshore Renewable Energy Strategic Action Plan (ORESAP) and was the result of a competitive tender process.

Brookfield Renewable Energy Group (TSX: BEP.UN; NYSE: BEP) operates one of the largest publicly-traded, pure-play renewable power platforms globally. Its portfolio totals approximately 6,700 MW of installed renewable capacity across 13 power markets in the United States, Canada, Brazil and Europe, with a focus on hydropower. Brookfield Renewable Energy Group recently added one of the largest renewable energy portfolios in Ireland to its portfolio. This portfolio, which is an important component of Brookfield's global growth plans comprises of 320 MW of operating wind capacity across 17 wind projects in eight counties as well as a development pipeline of 137 MW in construction, and employs around 75 people.

OpenHydro's business is the design, manufacture and installation of tidal turbines. OpenHydro has developed a strong capacity through the development of tidal energy projects in multiple global locations with a project portfolio spanning the USA, Canada, Ireland, Scotland, France and the Channel Islands. OpenHydro has significant expertise in developing tidal energy sites and advising on resource and environmental impacts associated with tidal energy development.

In March 2013 French industrial group DCNS secured a majority shareholding in OpenHydro. DCNS is a world leader in naval defence and an innovative player in energy. DCNS designs, builds and supports submarines and surface naval vessels and provides services for naval shipyards and bases. It also develops solutions in civil nuclear engineering and marine renewable energy. DCNS employs 13,200 people and generates annual revenues of €2.9 billion.

OpenHydro's achievements have been recognised through a number of prestigious international awards including, the Green Energy, Rushlight, Ocean Energy, and numerous Engineers Ireland awards. OpenHydro has the longest track record at the European Marine Energy Centre in Orkney. The company completed the installation of the first tidal turbine at this test facility in 2006 and in 2008 OpenHydro became the world's first company to connect a tidal turbine to the UK national grid. OpenHydro was also the first to successfully demonstrate a fast and economically viable deployment method for the installation of turbines at depth.

TVL harnesses years of experience, insight, research and technological solutions that both Brookfield Renewable Energy Group and OpenHydro have to offer. TVL is committed to innovating and leading the way for the future of

tidal energy, recognising its importance in the future supply of energy and contributing towards combatting climate change whilst bringing benefits to the local communities within which their projects are located.

TVL is in a position to support the attainment of the challenging Northern Ireland renewables target and, at the same time, enable Northern Ireland to become a world leader in the tidal industry and oversee the development of a significant local supply chain.

1.3 Project overview

In October 2012, TVL was awarded an Agreement for Lease (AfL) from The Crown Estate to exclusively investigate the feasibility of developing a commercial scale 100 MW tidal energy array in the waters offshore Torr Head on the north coast of County Antrim in Northern Ireland. The award forms part of Northern Ireland's Offshore Renewable Energy Strategic Action Plan and was the result of a competitive tender process. For TVL to be able to develop a tidal energy array within the AfL area, necessary development consents are required from the regulatory authorities.

The AfL covers an area of 6.8 km^2. The centre of the AfL area lies approximately 1 km offshore Torr Head 12 km east of Ballycastle and 11 km south east of Rathlin Island. Water depths within the AfL area range from 30 to 110 m at Lowest Astronomical Tide (LAT). Tidal currents within the AfL area average around 3 m/s with maximum flow speed of up to 5 m/s.

The offshore Project includes all components of the tidal energy array that are located seaward of the Mean High Water Spring (MHWS) mark. This includes the tidal support structures which will be used to attach the tidal turbines to the seabed, the tidal turbines, inter-array electric cables, which will connect each tidal turbine to the export cables, and the export cables which will bring electricity from the tidal array to shore. The export cables will come ashore at a suitable cable landfall location to the south of Torr Head. The current area of search for potential landfall locations extends south from Portaleen Bay to the southern end of Loughan Bay.

The maximum size of the tidal array will be 100 megawatts (MW). The Project is 'technology neutral' in that a preferred tidal turbine technology / device has not yet been selected. However, all turbines will be fully submerged and therefore will not be visible above the surface of the sea. The total number of turbines required to produce 100 MW will range from 50 to 100 turbines depending on the rating of the selected turbine technology.

The location of the AfL area, export cable corridor and potential cable landfall locations are illustrated in Figure 1.1.

1.4 The need for the Project

The key driver for the Project is the development of renewable sources of energy which is critical for combatting global climate change. At a local level, the Project will not only make a significant contribution towards achieving Northern Ireland's target of 40% electricity consumption from renewable energy sources by 2020[1] in line with UK and European renewable energy targets[2], but will also contribute towards achieving wider energy sustainability and economic benefits including:

- Increased security of energy supply;
- Reduced dependency on imported fuels and reduced exposure to fluctuating fuel prices;
- Increased energy infrastructure; and
- Generation of economic opportunities across Northern Ireland and in the local community within energy and marine related industries.

As well as contributing towards the creation of a more sustainable energy system for Northern Ireland, it is estimated that the Project will contribute up to 6% of the installed capacity towards the 40% renewable energy target for 2020. This is based on a site Maximum Export Capacity of 100 MW.

[1] As set out in Northern Ireland's Strategic Energy Framework (SEF) 2010 and the Northern Ireland Offshore Renewable Energy Strategic Acton Plan (ORESAP) (DETI, 2012)
[2] Kyoto Protocol 1997, UK Climate Change Act 2008, EU Renewable Energy Directive (2009/28/EC), UK Renewable Energy Strategy (2009), National Renewable Energy Action Plan (NREAP) 2010.

Figure 1-1 Location of the Project

1.5 Site selection and alternatives

1.5.1 Offshore project

The Torr Head AfL area lies within the Rathlin Island and Torr Head tidal resource zone, which was identified by the Department of Enterprise, Trade and Investment (DETI) as part of the Strategic Environmental Assessment (SEA) in its Offshore Renewable Energy Strategic Action Plan 2012, as having potential for the development of a commercial scale tidal energy array. The resource zone, which was then subject to further assessment as part of the preparation of the Regional Locational Guidance for the development of offshore renewables in Northern Ireland waters[3] was then offered to developers for the delivery of multiple projects up to 100 MW in size as part of The Crown Estate offshore wind and tidal stream leasing round for Northern Ireland.

As part of The Crown Estate lease application process, TVL carried out a number of assessments of the tidal energy levels in the Rathlin Island and Torr Head resource zone, identified as part of the SEA undertaken by DETI. Results from these assessments, combined with results from other studies looking at the characteristics of the seabed and environmental constraints in the area, were used to inform the selection of the area off Torr Head as TVLs preferred area of search for their tidal energy array. This was the area presented to The Crown Estate as part of TVL's lease application. An AfL for a second tidal energy project was also awarded to Fair Head Tidal. The Fair Head Tidal Energy Array Project area lies to the north west of the Torr Head AfL area (Figure 1.2).

Investigations into the development of a tidal energy array within the Torr Head AfL area have been on-going since the award of the AfL in 2012. These investigations include bird and marine mammal surveys, surveys to characterise the habitats present on the seabed (benthic) and along the shoreline at the landfall (intertidal surveys), deployment of Acoustic Doppler Current Profiler (ADCP) instruments to measure tidal flow and wave heights; a Navigational Risk Assessment to assess the potential risks to navigation in the area; review of existing geophysical data; and an offshore electrical cable architecture study. These studies have informed the EIA process and have been, and will continue to be, used by TVL to refine the design and layout of the tidal array and associated cables.

1.5.2 Onshore project

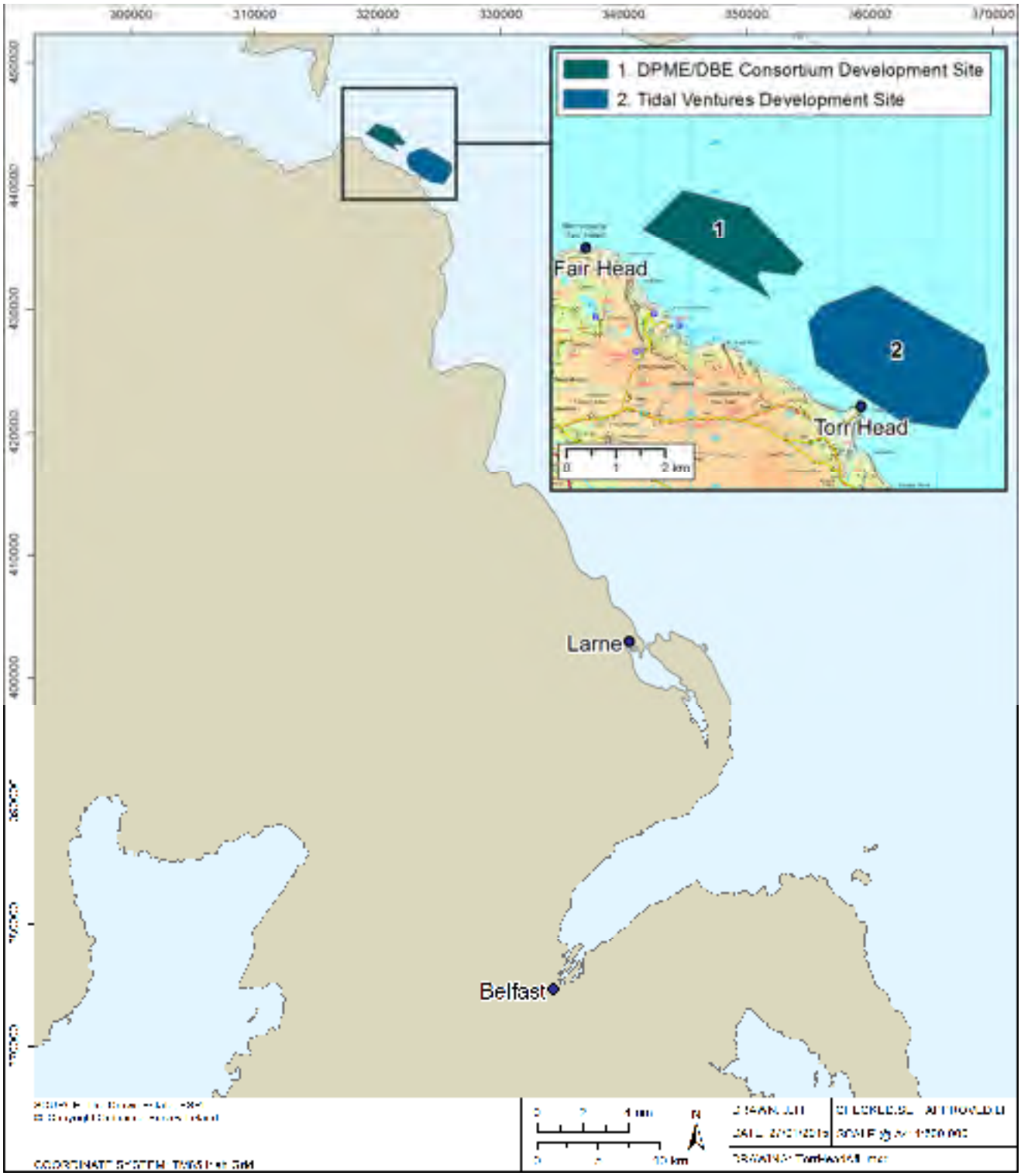
For electricity from the Torr Head Tidal Energy Array to be used to power people's homes and places of work, the array has to be connected to the Northern Ireland national electricity transmission network. TVL is responsible for bringing the export cables ashore for connection to a local substation, the construction of that substation and on-going connection to the national grid network is the responsibility of the grid system operator (System Operator Northern Ireland) and Northern Ireland Electricity. This part of the Project has been, and continues to be, the subject of ongoing discussions and studies and the location of the onshore connection is not yet known.

In order to inform the offshore Project and to progress parts of the onshore Project, TVL commissioned Fehily Timoney & Company to carry out an onshore feasibility study to identify potential cable landfall locations, onshore cable route and local substation sites. The study, which was primarily based on Geographical Information System constraints mapping and a site visit, covered an area extending from Ballycastle, east to Loughan Bay and south to Armoy and Ballypatrick Forest.

The main focus of the study was to identify a number of sites that would potentially be suitable for accommodating a local substation. Two types of substation were considered as part of the study, an Air Insulated Switchgear substation which utilises air to insulate outdoor electrical equipment and a Gas Insulated Switchgear substation where the electrical equipment is housed within a building. Both types of substations can be sympathetically designed to fit into the surrounding environment. Results from the study, which involved the gradual filtering, and removal of, potential locations depending on a range of environmental and human factors, identified 12 candidate sites from which a shortlist of sites were subject to more detailed appraisal to assess the sites in context of other components of the onshore Project e.g. potential landfall locations and onshore cable routes. Shortlisted candidate local substation sites will be taken forward for more detailed appraisal as part of the ongoing development of the onshore Project.

[3] Regional Locational Guidance for the development of offshore renewables in Northern Ireland waters, (DETI, 2011).

Figure 1-2 Torr Head and Fair Head Tidal AfL areas



1.6 Regulatory consent

Due to the uncertainty as to how, and where, the Project will be connected to the national grid network, it has not been possible at this stage to finalise the design of the onshore Project. This EIA therefore covers the offshore components of the Project (Part 1) up to Mean High Water Spring (MHWS).

There are a number of regulatory consents required for the offshore Project. These include a Marine Licence from the DoENI Marine Division, under the Marine and Coastal Access Act 2009 which is required to place objects on the seabed which includes marine renewable energy devices and associated infrastructure. Consent is also required from DETI under Article 39 of the Electricity (Northern Ireland) Order 1992 to construct and operate generating stations i.e. turbines which will produce in excess of 1 MW of power.

The EIA for the offshore Project has been produced under the Marine Works (Environmental Impact Assessment) Regulations 2011 and the Offshore Electricity Development (Environmental Impact Assessment) Regulations (Northern Ireland) 2008. The resulting ES and this NTS are being submitted as part of the Marine Licence and Article 39 consent applications.

The onshore components of the Project (Part 2) will be subject to separate consent under the Planning (Northern Ireland) Order 1999. A full EIA will be carried out in accordance with the Planning (Environmental Impact Assessment) Regulations (NI) as amended by the Planning (Environmental Impact Assessment) (Amendment) Regulations (Northern Ireland) 2008 to assess the potential impacts of the onshore components of the Project on the environment. The proposed scope of the onshore ES was included in the Torr Head Tidal Energy Array EIA Scoping Report which was submitted to DoENI Marine Division and DETI in June 2013 and the EIA Scoping Opinion provided by DoENI Marine Division and DETI in February 2014. Information in these two documents will be taken into account in the preparation of the ES which TVL expects to submit to DoENI Planning Service as part of the onshore planning application in late 2015.

Potential effects of the offshore Project on sites of European conservation importance (Natura sites) have also been assessed through a Habitats Regulations Assessment (HRA) carried out in line with the requirements of the Habitats Directive[4] and the Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995). Although information collated during the EIA has informed the HRA, each assessment is a separate process carried out under different legislation. Results from the HRA are presented in a HRA Report which is being submitted with the ES for the offshore components of the Project to provide information for an Appropriate Assessment. Screening will also be carried out as part of the HRA process to determine whether there is potential for the onshore Project to have any adverse effects on a Natura site.

1.7 Scoping, consultation and public events

Since the award of the AfL in October 2012, TVL has been actively consulting, and will continue to consult beyond submission of the consent application, a wide range of statutory and non-statutory stakeholders and other interested parties. All consultation has been carried out in line with the relevant EIA legislation and Guidance on Marine Licensing[5].

In November 2012, a letter and press release was issued to all statutory and non-statutory stakeholders informing them of the AfL award, introducing the Project and TVL and inviting them to attend meetings to discuss the Project in more detail. Meetings have been held with 37 organisations since November 2012 with more than 50% of the organisations met on more than one occasion.

A large number of meetings occurred in November 2012 following distribution of the initial Project Introduction letter. Further meetings were held in spring 2013, following the distribution of a Pre-EIA Scoping Request for Information Letter by TVL in February 2013. TVL subsequently issued further Project update letters in June and December 2013 which led to a number of additional meetings being held.

[4] EC Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna
[5] Northern Ireland Guidance on Environmental Impact Assessment under Part 4 of the Marine and Coastal Access Act 2009. Department for Environment (DoENI) Northern Ireland, 2012.

Throughout the EIA process, communications on the Project have been issued to stakeholders in a number of ways. As detailed above, project update letters/press releases were issued throughout the EIA process. The TVL Project website (www.tidalventures.com) was launched in November 2013 detailing information on TVL, the Torr Head Tidal Energy Array Project and providing a 'frequently asked questions' section for stakeholders and interested parties to view. A Project brochure was also compiled for distribution at meetings and at the Public Consultation Event.

1.7.1 Consultation with the local community

The Public Consultation Event was held on the 5th November 2014 in the Marine Hotel in Ballycastle. The event was advertised in local papers and posters displayed in shops, libraries, hotels, local clubs and other public buildings in the Cushendall, Cushenden, Rathlin Island, Ballycastle and Moyle District Council areas. The event was attended by approximately 55 people from a range of organisations including statutory and non-statutory stakeholders and members of the public. Display boards presenting information on the Project were set up on the day, with an opportunity provided to all attendees to discuss any queries or concerns on the Project and provide feedback on the day or at a later date.

Copies of the display boards from the event and supporting information on the Project have been uploaded to the Project website (http://www.tidalventures.com) to facilitate consultation with a wider audience.

1.7.2 Fisheries consultation

The local fishing community is seen as an important and key stakeholder to the EIA process. To maintain ongoing consultation and liaison with the fishing community a Fisheries Industry Representative was appointed to the Project in November 2012 to facilitate communication between the local fishing community and the appointed Fisheries Liaison Officer. All consultation with the local fishing community was carried out in accordance with the FLOWW Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison (January 2014).

1.7.3 EIA Scoping

Consultation on the EIA Scoping Report[6] was carried out by DoENI Marine Division on behalf of both DoENI and DETI. The organisations consulted on the scope of the EIA are listed below.

- Agri-Food & Biosciences Institute (AFBI)
- Centre for Maritime Archaeology (CMA)
- Commissioners of Irish Lights (CIL)
- The Crown Estate (TCE)
- Department of Enterprise, Trade and Investment (DETI)
- Department of Agriculture & Rural Development (DARD) (Fisheries Division)
- Department of Culture Arts & Leisure (DCAL) (Salmon, eels etc)
- Northern Ireland Environment Agency (NIEA)
- DoENI Marine Division, Nature Conservation
- DoENI Marine Division, Marine Monitoring
- Maritime and Coastguard Agency (MCA)
- Marine Scotland (MS)
- Moyle District Council
- Environment Protection Agency (EPA)
- Department of Communications, Energy and Natural Resources (DCENR)
- Scottish Natural Heritage (SNH)

[6] TVL (2013). Torr Head Tidal Energy Array EIA Scoping Report. Report prepared by RPS on behalf of Tidal Ventures Limited. June 2013.

The EIA Scoping Opinion[7] set out requirements for the EIA and provided details on the view from regulatory bodies and other key stakeholders on what they deemed necessary for consideration by the EIA and reported in the ES. Where required, further meetings and discussion were held in order to refine the scope of the specific EIA studies and discuss certain topics in more detail. Further detail on all consultation carried out as part of the EIA is provided in Chapter 6 of the ES

1.7.4 ES pre-submission Consultation

Prior to final submission of the ES, draft copies of key chapters of the ES were submitted to DoENI Marine Division for review. A number of stakeholders (statutory and non-statutory) were invited by DoENI Marine Division to provide comments on these draft ES chapters. In addition to providing written comments, stakeholders were given the opportunity to provide feedback on, and discuss, the draft ES chapters at a meeting that was held at NIEA's offices in Lisburn, Belfast on 20th January 2015.

1.7.5 Post Submission Consultation

Following submission of the Marine Licence Application, notice of the application will be advertised in local newspapers in the Antrim area. This is to allow the public an opportunity to review the application, ES or request a copy of the submission. A statutory public consultation period of 42 days will remain open to allow written representations on the Project to be made.

Consultation will continue beyond the submission of the application. Assuming successful award of Project consent, licence condition implementation, including the development of appropriate environmental monitoring protocols, will require continuing engagement and consultation with the regulators and their statutory consultees. In addition, TVL will continue its communications with local marine users, the local community and wider public to keep them informed of the Project progress and key milestones.

[7] DoENI Marine Division and DETI (2014). Scoping Opinion for Tidal Ventures Limited Proposed Torr Head Tidal Scheme, North Antrim Coast, Northern Ireland

2 PROJECT DETAILS

2.1 Project description

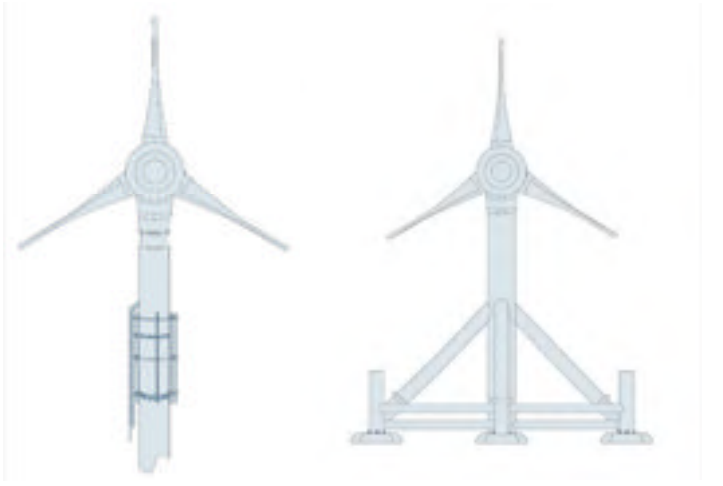
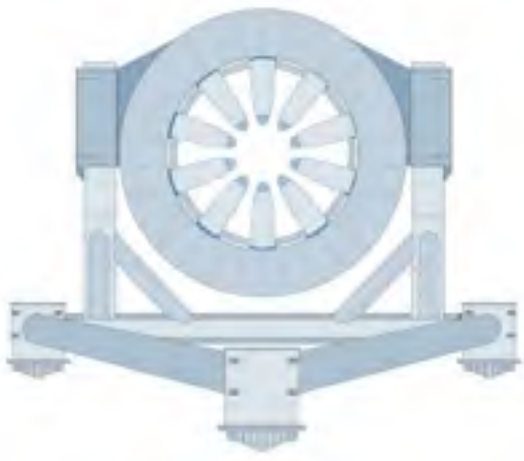
In order to ensure that the most economically advantageous technology can be deployed at the project site, it is considered prudent at this stage to allow for flexibility in the choice of technology. Consideration has been given to the most advanced technologies currently available, as well as limiting the range of potential environmental impacts that need to be considered. Accordingly, a project description has been chosen which allows for flexibility in technology choice. The Project description has been developed in line with the established principles of the Rochdale Envelope[8] (also referred to as the design envelope). The basis of the design envelope is to apply a "worst case" approach to the assessment of the environmental impacts associated with the Project. This ensures that all possible Project options are considered as part of the EIA, whilst maintaining sufficient flexibility within the Project description to allow for the ongoing design, technological and engineering evolution of specific elements of the Project to continue beyond submission of the Marine Licence application.

The Project includes the construction, installation, operation and maintenance and decommissioning of between 50 and 100 fully submerged tidal turbines with capacity to produce up to 100 MW of electricity. The total number of turbines installed in the array will depend on the rated capacity[9] of the selected turbine technology. This is expected to range between 1 MW and 2 MW per turbine, although this could increase to more than 2 MW as turbine technologies continue to evolve.

2.1.1 Tidal turbines

The tidal turbines will be attached to, or mounted on, the seabed. The range of turbines to be selected include those with a rotor, either supported on a nacelle or as a ring generator. The diameter of the turbine rotors included in the design envelope range from 13 m to a maximum 23 m. The tidal turbines will either be shrouded or unshrouded. The shrouded tidal turbine has one rotor comprising 10 closely arranged blades. The unshrouded tidal turbine has one rotor with a maximum of three blades. The different types of turbines are illustrated in Figure 2.1 below.

Figure 2.1 Illustration of tidal turbines

Unshrouded turbine	Shrouded turbine
	

[8] R.v Rochdale MBC ex parte Milne (No.1) and R. v Rochdale MBC ex parte Tew [1999] and R. v Rochdale MBC ex parte Milne (No.2) [2000].
[9] Amount of electricity operational turbines can produce

The selected turbine will have a minimum clearance above the top of the highest point (i.e. blade tip) to the sea surface of 8 m at the lowest astronomical tide (LAT) and will have a minimum clearance from the seabed to any moving components of at least 4 m. All tidal turbines use the flow of water generated by tidal currents to generate electricity by turning the blades of the rotor. Some of the tidal turbines have minimum and maximum operating speeds whilst others can continue to produce electricity when water movement is extremely low at slack tide or at high flow during mid-tide.

There are three options for securing the tidal turbines to the seabed. Two involve drilling into the seabed and installing either a large single pile (monopile), or three smaller pins to secure a tripod to the seabed (drilled pin pile tripod). The third option uses the weight of a large steel and/or concrete structure to hold the structure to seabed (gravity base structure or sub-sea base). The Project does not include any options for percussion piling to secure the turbines to the seabed.

2.1.2 Turbine layout

The layout of the tidal turbines depends on a number of factors including the type of turbine selected and method of attachment to the seabed, the condition of the seabed (e.g. if it is rocky or smooth, sloping or flat), the direction of flow and speed of the tidal currents and whether the area is affected by turbulence or high waves. Given that a preferred tidal turbine technology has not yet been selected, the final layout of the tidal turbines within the array is not finalised and will not be determined during the detailed design stage (post consent). However, an indicative turbine layout has been provided below (Figure 2.2) as an example of how the tidal turbines could be arranged within the AfL area.

Figure 2.2 Indicative turbine layout

2.1.3 Inter-array and export cables

Inter-array cables will be used to transfer electricity from the individual tidal turbines to the export cables. The inter-array cables will be connected to the export cables via a maximum of eight submerged cable connection hubs. A maximum of eight export cables will then be used to export electricity to shore. Both the inter-array and export cables are likely to transmit electricity at a voltage of up to 40 kilovolts (kV). The inter-array and export cables will be laid across the surface of the seabed. To protect the export cables from damage caused by other sea users such as boat anchors it may be necessary to cover the cables with rocks, grout bags or concrete mattresses.

Each export cable will have a diameter of approximately 500 mm, in the worst case if cable protection is used this could extend to 2.5 m on either side of the cable. If in the worst case 8 cables are required this would result in a maximum width of 40 m of the seabed being occupied by cables export cables. The width of the spacing required between each export cable increases as the depth of the water along the cable route increases to facilitate cable installation. If 8 export cables are used they would be spread across a cable corridor with a maximum of 1,260 m wide and 3 km long. However, the area of seabed between each export cable will remain completely unaffected by the Project.

2.1.4 Cable landfall

The export cables will be brought ashore at a suitable location within the landfall area of search which extends south from Torr Head at the northern end of Portaleen Bay (Figure 2.3) to the southern end of Loughan Bay (Figure 2.4). As the export cables reach the landfall they will be buried below existing ground level / seabed levels in either a trench, or a duct created using a technique called Horizontal Directional Drilling (HDD).

Figure 2.3 Portaleen Bay

Figure 2.2 Loughan Bay

2.1.5 Turbine and cable installation

Depending on the selected technology, the tidal turbines will either be fully assembled onshore (attached to the turbine support structure) and transported to the AfL area for deployment as a complete unit or transported separately for attachment to the pre-installed turbine support structures. Installation of both the tidal turbines and turbine support structures will occur over a period of two to three years. Turbine installation will generally be carried out during the summer (e.g. April to September / October) when weather conditions are most favourable. However, turbines can be installed all year round depending on seabed and tidal flow characteristics within the AfL area and suitable weather conditions. However, it may also be possible for some installation to occur in winter subject to favourable weather conditions. The inter-array and export cables will be installed at the same time as the tidal turbines.

Installation of the turbines and cables will involve one to two construction vessels or a barge fitted with heavy lift equipment which will be used to lift the turbine support structures and turbines into the water. Depending on the selected tidal turbine technology it may be necessary to use moored or jack-up barges instead of the construction vessel(s). Smaller vessels will also be required to support turbine installation activities. These will include dive boats, boats carrying a Remotely Operated Vehicle (ROV), crew transfer vessel to transfer crew between the construction vessel and shore, tug boats and Rigid Inflatable Boats (RIBs). A specially designed cable lay vessel will be used to install the inter-array and export cables.

2.1.6 Tidal array operation and maintenance

Once installed, the tidal array will have an operational life of 25 years during which the turbines will be controlled remotely via an onshore control system. The tidal turbines will also contain an on-board monitoring system which will monitor the performance of each turbine throughout its operational life.

Maintenance of the tidal array will be carried out on a regular basis. This will include routine inspections of the tidal turbines and cables using ROVs. If any repairs are required, these will either be carried out on site or, for more major repairs, the turbines will be removed from the water using a heavy lift vessel and transferred onshore. Depending on the level of work required, repair work and / or maintenance will either be carried out at the quayside or at specialised workshops.

Once repairs / maintenance are complete the tidal turbine will be returned to the water. Some turbines will be removed from the water as part of routine planned maintenance. This would involve a complete overhaul of the turbine and would be carried out every 5 to 10 years.

It is likely that maintenance activities will be carried out throughout the year. On average there is expected to be one vessel present each day. However, the total number of vessels present in the area at any one time will depend on weather and tide conditions and level of maintenance required. Routine maintenance will require one small vessel with an ROV whereas the vessels involved in the removal of a turbine will be similar to those used during turbine installation e.g. heavy lift crane construction vessel / barge and support vessels. It is likely that these vessels will only be present in the area for short periods of time during turbine removal and reinstallation.

The location of the onshore base for operations and maintenance activities has not yet been identified as this will be dependent on the selected tidal turbine technology.

2.1.7 Decommissioning

Two options will be considered at the time of decommissioning: repowering the site using commercially available technology (subject to securing all necessary permits and consents); or decommissioning the array in accordance with the requirements of the Energy Act 2004 and conditions of The Crown Estate AfL, which requires full decommissioning of the site within 24 months of electricity production ceasing.

2.2 Programme

Procurement and manufacture of the tidal turbines will commence in 2016. The turbines will then be installed in two phases over a two year period with Phase 1 commencing in 2018 and Phase 2 in 2019. Phase 1 will involve the installation of 15 – 30 turbines and Phase 2 will involve the installation of 35 to 70 turbines. The total number of turbines installed for each phase will depend on the power rating (MW) of the turbines. The inter-array and export cables will be installed at the same time as the tidal turbines. Each phase will be brought into operation once installation is complete. The onshore components of the Project (local substation and grid connection) is also due to be constructed in two Phases during 2018 and 2019, to coincide with installation of the tidal turbines. The entire tidal array is expected to be fully operational by late 2020.

3 ENVIRONMENTAL IMPACT ASSESSMENT

An EIA was undertaken to assess the potential impacts of the proposed Torr Head Tidal Energy Array Project on the environment and other sea users. Impacts have been assessed for all stages of the Project from installation through to decommissioning. The impact assessment has been undertaken following standard EIA methodologies, established guidance and has been informed by a number of Project specific surveys and specialist studies.

For all topics covered by the EIA the approach has been to assess the maximum potential impact of the Project based on the "worst case" Project parameter defined by the Project design envelope. This approach of using the design envelope to assess the worst case project parameters has evolved over recent years as a result of lessons learned from previous projects and relevant case law. The Project parameters resulting in the greatest potential environmental impact vary between topics and therefore have been defined throughout the assessment on a topic by topic basis. Variations in the predicted impacts based on different design options were also considered.

3.1 Environment overview

The Project is located off Torr Head on the western edge of the North Channel, a stretch of water that separates the coast of Antrim in Northern Ireland with the Kintyre peninsula in Scotland. The North Channel is approximately 20 km wide at the narrowest point (between Torr Head and south west Scotland). Water depths within the channel are typically between 100 m and 200 m but reach up to 280 m depth in some locations. Although water depths along the Antrim coast are shallower, there are some areas of deeper water including the Torr Head AfL area where average water depths are approximately 60 m. Water depths in the export cable area of search increase steadily from the shore to depths of around 50 m at the edge of the AfL area.

Being located off the north east coast of Northern Ireland the AfL area is surrounded by land to the west (Ireland) and east (Scottish mainland) and therefore is well sheltered from large waves coming in from either the Atlantic (towards west coast Ireland) or the North Sea (east coast England and Scotland). Tidal currents within the AfL area are however, significant, averaging up to 3 m/s along the coastal edges of the North Channel on a spring tide.

The seabed within the AfL forms part of an irregular rock outcrop which is interspersed with boulders and cobbles. Along the export cable corridor the seabed is comprised of a mixture of areas of exposed bedrock, coarse gravels and sands, and small areas of sand megaripples. The seabed in the AfL area supports a range of species of flora and fauna that are commonly found on rocky seabed in areas of fast tidal currents.

There are a number of sites of European nature conservation importance located in the vicinity of the Project area[10] that are designated for the protection of seabirds or marine mammals (Figure 3.1). However, although a range of different species of seabirds and marine mammals (e.g. whales, dolphins, porpoise and seals) have been recorded in the AfL area, and surrounding waters, during surveys undertaken by TVL, most species are only present in low numbers. The AfL area, and surrounding waters, is therefore not considered to be of high importance as a key foraging or breeding area for either seabirds or marine mammals.

The main fishing activity within the Project area has been identified as potting for lobster and crab. There is also a salmon fishery which operates off Torr Head, although this has not been operational since 2012. There are no significant fish spawning or nursery areas present in the Project area. The AfL area lies approximately 1.5 km south west of the North Channel Traffic Separation Scheme which was put in place to improve the safety of vessels passing north and south along the main North Channel shipping route. The AfL area also lies to the south of the main route east west used by vessels travelling to or from Ballycastle. The majority of vessels observed passing through the AfL area during surveys undertaken by TVL were fishing boats and recreation sailing yachts.

Although there are records of known wreck sites/ wrecking events and some small anomalies within the Project area, no shipwrecks or related significant archaeological material has been detected during any surveys of the seabed. Due to the fast tidal flow and hostile nature of the seabed within the AfL area it is highly unlikely that any shipwreck in this location would remain intact for any length of time.

[10] For the purposes of this environment description the Project area is defined as the AfL area and export cables area of search.

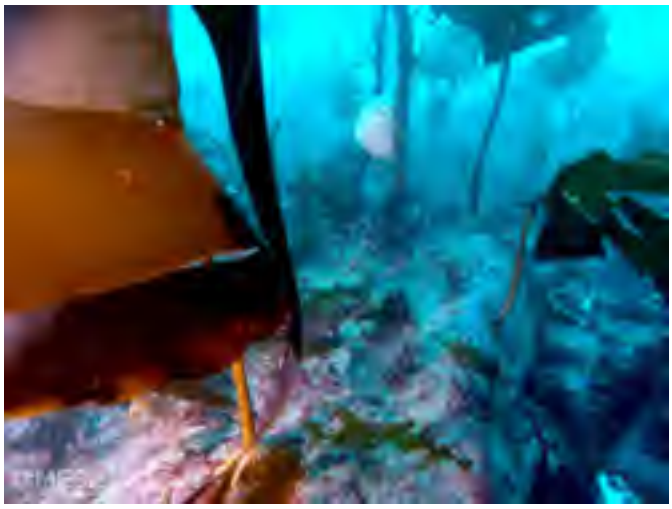
The nearest designated bathing beach is at Ballycastle approximately 11.5 km west of the AfL area. There is no existing offshore infrastructure in the immediate vicinity of the AfL area. The Rathlin Island submarine interconnector cable which runs from Ballycastle to Rathlin Island is located approximately 11 km to the west of the AfL area. The AfL area and surrounding waters have, however, been identified as a potential area of interest for oil and gas exploration.

The entire stretch of the North Antrim coast and adjacent hinterlands, is located within the Antrim Coast and Glens Area of Outstanding Natural Beauty (AONB). The exposed headland, sheltered bays and rocky outcrops found at Torr Head, combined with dramatic views across to south west Scotland and the strong sense of remoteness, naturalness and relative inaccessibility of this part of the coast are key characteristics of the local landscape and important features of the AONB designation. The AONB is a key visitor attraction where activities include walking, cycling and general sightseeing. Other tourist and recreation activities in the area include sea angling and diving.

3.2 Benthic and intertidal ecology

The assessment of impacts on benthic ecology was informed by results from a benthic characterisation survey which was carried out in September 2014. The survey, which was planned using previously obtained geophysical data covering the Project and surrounding area, was based on drop down video and stills photography. An intertidal survey of the potential export cable landfall locations at Portaleen Bay and Loughan Bay was also carried out in September 2014.

Results from the benthic characterisation survey found the majority of the AfL area to be predominantly composed of exposed bedrock, boulders and cobbles. The export cable corridor contains more variable seabed, including areas of exposed bedrock, coarse gravels, sandy gravels and small areas of sand megaripples. Across the majority of the Project area, the surfaces of rocks and boulders are covered in a faunal turf consisting of a diverse range of benthic organisms including hydroids, bryozoans and sponges that are characteristic of rocky surfaces, in particular the *Tubularia spp* hydroid, which is commonly found on rocky surfaces exposed to surge or strong tidal flow. Other fauna such as starfish, sea urchins and sea cucumbers were also present.



The potential cable landfall locations at Portaleen Bay and Loughan Bay are dominated by boulders and patches of outcropping bedrock interspersed with small areas of gravel or pebble beach. Species diversity within the intertidal area is limited with 'intertidal under boulder communities' exhibiting low species diversity. Patches of macroalgae and associated communities, including *Ascophyllum nodosum*, which is listed as a NI priority species are present in areas covered by seawater for most of the time and areas surrounding the rock platforms.

As a result of the small scale of the Project footprint, absence of PMFs, the high energy environment and widespread representation of the habitats found in the Project area throughout much of the surrounding area, all but one of the potential impacts has been assessed as not significant.

The potential introduction of Marine Non-Native Species (MNNS) as a result of installation and maintenance vessels entering the Project area has been identified as a potentially significant impact. This is on the basis that there is a high degree of uncertainty regarding the origin of the vessels transiting to the Project area, the type and quantity of MNNS that have the potential to be introduced from those locations, and the potential impact of those MNNS in local ecosystems. To avoid these significant impacts, any vessel involved in the Project will be subject to a full risk assessment to determine the potential for the introduction of MNNS. Any mitigation methods identified during this assessment will also be strictly adhered to. The residual impact is therefore predicted to be not significant.

Overall there are predicted to be no significant impacts on benthic and intertidal ecology associated with the Project.

3.3 Marine mammals

A number of desk based studies and marine wildlife surveys undertaken by TVL were carried out to characterise the use of the Project area by marine mammals. The desk studies found that 15 species of whale and dolphin have been recorded in the vicinity of the Project area, although most are not considered regular visitors. The marine wildlife surveys confirmed that, of the species recorded as being present in the Project area, harbour porpoise occurs most frequently. Bottlenose dolphin and minke whale were also recorded in the Project area but only in low numbers. The wildlife surveys also recorded low numbers of grey and harbour seal in the Project area.

All whales and dolphins are protected under Annex IV of the EU Habitats Directive. Bottlenose dolphin, harbour porpoise, harbour seal and grey seal are also protected under Annex II of the Habitats Directive, which requires the designation of Special Areas of Conservation (SAC) for the species. The nearest SAC to the Project area where marine mammals are a qualifying interest is the Skerries and Causeway SAC which lies approximately 25 km north west of the AfL area. Harbour porpoise are a qualifying interest of this site.

Although the Project area is not regularly used by high numbers of marine mammals there is potential for some interactions to occur between animals foraging in, or transiting through the AfL area. Where there are interactions, the main source of potential impacts on marine mammals have been identified as noise emissions from vessels involved in installation and maintenance activities and the potential for animals to collide with operating turbines.

Modelling carried out to inform the assessment of impacts from underwater noise and collision with operational tidal turbines concluded these impacts to be not significant. With regard to harbour porpoise which are the most frequently occurring marine mammal in the area and most sensitive to underwater noise, it was concluded that there is potential that vessel noise could disrupt normal behaviour within 5 km from the AfL area. However, such disruption would be limited to temporary effects on foraging, if any affects occurred at all, and would only affect a small proportion of the local population.

Results from the encounter modelling showed that with an assumed avoidance rate of 98% (which has been used in other tidal developments as a realistic avoidance rate) the number of harbour porpoise which might be affected would not have any impact on the local population. As avoidance rates decrease the potential for population level impacts increases. However, avoidance rates would need to reduce to 79% before there would be any potential effect on the local population. This rate of avoidance, based on known behaviour of harbour porpoise is considered to be highly unlikely. Given that other marine mammals are found much less commonly at the site, there is limited scope for interaction with the devices and consequently unlikely to be population level effects. Potential impacts due to collision risk were therefore assessed to be not significant.

The assessment also identified a potential risk of injury to small marine mammals (e.g. harbour porpoise and seals) through the use of vessels with ducted propellers ('corkscrew injury') during installation and operation. However, very recent evidence from observations of grey seals in Scotland in December 2014 strongly suggests that

corkscrew injuries are actually caused by seals themselves and are the result of attacks by adult male grey seals on grey seals pups. This evidence, which includes video footage of the attacks, is supported by similar evidence obtained during a two year monitoring study along the coast of Germany where adult grey seals were witnessed carrying out predator attacks on young harbour seals. The extent to which non-seal species might be affected is unclear, although reports of similar injuries to harbour porpoises do exist.

Although no significant impacts are predicted in light of this new evidence, impacts from vessels cannot totally be ruled out given that previous studies have indicated that ducted propellers could cause such injuries. TVL is therefore committed to undertaking frequent reviews of the literature regarding this topic and to regularly discuss advances in understanding of this topic with relevant regulatory and advisory bodies. If impacts from vessels cannot be ruled out then appropriate mitigation will be put in place to ensure that significant impacts do not occur.

Overall there are predicted to be no significant impacts on marine mammals associated with the Project. However, TVL does acknowledge that there is still a lack of evidence and uncertainty around the potential for impacts from collision with operating turbines and recognises the need to implement an adaptive marine mammal monitoring programme to confirm the predictions made with regard to collision risk impacts. This monitoring programme will be developed in consultation with the regulator and other relevant stakeholders.

3.4 Ornithology

Of the 24 species of seabird recorded in the vicinity of the Project area during the marine wildlife surveys undertaken by TVL, most birds were only present in very low numbers. It was therefore concluded that the Project area is not a key foraging area for seabirds. The most frequently recorded species were guillemot and razorbill. Given that both species are known to regularly dive to depths of below 8 m they were identified as being potentially at risk of impacts from the tidal turbines. Other diving birds recorded in the Project area included eider, common scoter, goldeneye, red-throated diver, great northern diver, gannet, cormorant, shag, puffin and black guillemot. Northern fulmar, Manx shearwater, storm petrel, great skua, sandwich tern, arctic tern, kittiwake and black-headed, common, lesser black backed, herring and greater black backed gulls were also observed during surveys.

There are several Special Protection Areas (SPAs) in the vicinity of the Project where seabirds are qualifying interests including Rathlin Island SPA and Sheep Island SPA. Although there are other SPAs in the area e.g. Antrim Hills SPA, Lough Foyle SPA, Larne Lough SPA, Belfast Lough SPA and Lough Neagh and Lough Beg SPA, none of the birds which are a qualifying interest of these sites were observed to be present in the Project area. Therefore it was concluded that these sites would not be affected by the Project.

Due to the small scale of the Project, temporary nature and short duration of installation activities, low number of installation vessels and low numbers of seabirds observed in the Project area, all potential impacts on seabirds during installation were concluded to be not significant. Impacts on diving birds during operation (displacement due to presence of turbines and collision risk impacts) were also assessed to be not significant due to the small scale of the Project and relative low importance of the Project area as a key foraging ground for seabirds.

3.5 Fish and shellfish ecology

A range of fish and shellfish species occur within the Project area and surrounding waters, some of which are critically endangered e.g. cod and protected both at an international and UK level. The Project area lies within a potential spawning ground for sprat and nursery grounds for various species including herring, mackerel, cod, European hake, whiting, spurdog and common skate complex. There is potential for both brown crab and lobster to also be present in the Project area.

The Glendun River, which is located approximately 9 km to the south of the Project area, is used by migratory Atlantic salmon and sea trout. The nearest European protected sites for Atlantic salmon are the River Roe and River Foyle which are located approximately 74 km and 84 km respectively from the Project area.

All impacts on fish and shellfish were assessed to be not significant. For most impacts, the relatively small scale of the Project footprint compared to the extent of potential spawning and nursery grounds and distribution of crab and lobster habitat, significantly limits potential impacts on most fish and shellfish species. The highly dynamic nature of the marine environment within the Project area means any discharges (e.g. drill cuttings or pollutants) are rapidly dispersed into surrounding waters reducing the potential for any significant effects.

Results from the noise modelling indicated that the maximum distance from installation and maintenance vessels within which even the most noise sensitive of fish species (herring) may experience some disturbance is 450 m. Noise from operational turbines is only expected to be detectable by most fish species within a few 10's of meters from the turbines.

Although the Project area lies on the western edge of the North Channel which is a key migratory route for various fish species including Atlantic salmon, the likelihood of salmon encountering the tidal turbines and this resulting in a fatal collision was assessed to be very low. This is mainly due to the relatively small scale of the Project, the ability of salmon to detect and avoid objects in the water column and the fact that salmon tend to swim close to the sea surface (usually within in the upper 5 - 10 m of the water column) and are therefore more likely to swim over the array than through it. These swimming patterns also reduce the potential for the tidal array to present a physical barrier to the movement of salmon through the North Channel. The tidal array is expected to occupy at most, approximately 0.37% of the total available sea area within the North Channel[11]. Potential impacts on migratory Atlantic salmon due to barriers to movement are therefore assessed to be not significant.

Both the inter-array and export cables are likely to be surface laid. Cable protection measures used to protect these cables from damage e.g. protective armour casings (inter-array cables) or cable protection measures e.g. rock placement, concrete mattresses or grout bags will also minimise electromagnetic field (EMF) emissions from these cables. Given the small scale of the Project and relatively low voltage of the cables (up to 40kV), it was concluded that EMF impacts on fish and shellfish would be not significant.

3.6 Commercial fisheries

Information was obtained from a number of sources to inform the assessment of impacts on commercial fisheries including information obtained from local fishermen through consultation meetings. A review of this information indicates that the most targeted commercial fisheries species in the vicinity of the Project area are shellfish, in particular crab and lobster landed using creels / pots along the coast. There is also a salmon fishery located at Portaleen Bay. While this has not been operational since 2012 there is potential that salmon fishing at Portaleen could resume in the future.

To ensure the safety of all personnel involved in the installation of the Turbine Support Structures (TSSs), turbines and cables it will be necessary to implement safety zones of up to 500 m radius during installation. These will be implemented in accordance with the Department for Energy and Climate Change (DECC) guidance and will be installed on a rolling basis around areas where installation activities are taking place. Given that fishing vessels will not be permitted within the safety zones it is predicted that this will result in the temporary displacement of fishermen from fishing grounds within the Project area where safety zones

[11] Total swept area of the tidal array (area of water column occupied by turbine blades) is 8,300 m^2. This is based on a maximum swept area per turbine of 415 m^2 (based on a maximum turbine blade radius of 23 m) and assumes a maximum of 20 turbines per row (on an east west alignment). The total sea area of the North Channel (approximately 2,273,000 m^2) represents the area of water from the seabed to sea surface running from one side of the channel to the other taken at the narrowest point.

are in place. However, due to the temporary nature and short duration of potential displacement and the small scale of the area within which displacement will occur, the impact of this on local fisheries was assessed to be not significant.

There is however, potential for significant impacts on local fisheries due to long term displacement from crab and lobster fishing grounds within the AfL area during operation as it will not be possible for fishermen to continue to deploy crab and lobster pots within the tidal array. Restrictions on crab and lobster potting could cover the entire AfL area (6.8 km^2). However, it is likely that the area of seabed occupied by the final array layout will occupy a smaller footprint within the AfL area (Figure 2.2). Once the export cables and associated cable protection measures are installed it will be possible for lobster and crab potting activities to resume within the export cable corridor reducing the potential for any significant impacts on fishing activities in this area.

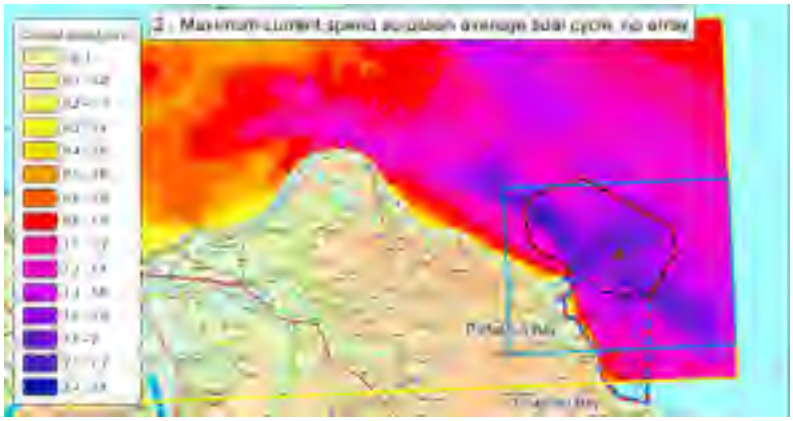
In order to reduce the potential for significant impacts on local fishermen, TVL plans to work with all those involved in the fishing industry to ensure minimal impact to anyone working in the area. Where genuine financial loss can be demonstrated compensation will be considered on the basis of factually accurate and justifiable claims. TVL will also continue consultation and liaison with the local fishing industry through the appointed Fisheries Liaison Officer (FLO). All consultation will be carried out in accordance with the Fishing Liaison with Offshore Wind and Wet Renewables (FLOWW) Best Practice Guidance for Offshore Renewable Energy Developments. Consultation will be carried out throughout the installation phase and during operation as necessary.

The assessment also considered impacts on the Portaleen salmon fishery. This fishery, which is currently not in operation, relies on catching salmon passing Torr Head. Although there is potential that noise and vessel presence during installation could deter salmon from passing through the Project area, this impact would only be temporary and usual salmon movements if affected are expected to resume once installation is complete. Impacts on the fishery during installation would therefore not be significant. Given that the operational tidal array is not expected to present a barrier to the movement of salmon past Torr Head on the basis that salmon will be still be able to move freely over the top of, or around the array (as discussed in the fish and shellfish assessment) and that the likelihood of salmon encountering and subsequently colliding with operational turbines is also considered to be negligible, impacts on the Portaleen salmon fishery during operation are also assessed to be not significant.

However, to ensure that this remains the case, TVL will remain in dialogue with the owner of the fishery and in the event that the fishery becomes operational again during the lifetime of the Project will agree a proposed monitoring plan to confirm that there are no significant impacts on the fishery. Where genuine financial loss can be demonstrated as a result of the project activities compensation will be considered on the basis of factually accurate and justifiable claims.

3.7 Coastal processes and seabed conditions

The seabed within the AfL area is made up of hard exposed rock outcrops with areas of cobbles and boulders, whereas the seabed along the export cable corridor is more varied with areas of exposed bedrock, coarse and sandy gravel and small areas of sand megaripples. The coastline surrounding the Project area is dominated by rocky cliffs interspersed with occasional headland bays with small beaches.



The average water depth across the AfL area is approximately 60 m. Shallowest areas (approximately 35 m depth) are located towards the north-eastern corner of the AfL area, with the deepest sections (approximately 90 m and 110 m) found along the north and south-eastern edges of the AfL area. Water depths within the export cable area of search increase steadily from the coastline down to a depth of approximately 50 m at the edge of the AfL area.

Being located on the north east coast of Northern Ireland, the AfL area is sheltered by the mainland from the large swell waves that are found off the west coast of Ireland and by the Scottish mainland from waves coming from the north and east. Consequently wave height within the AfL area rarely exceeds 2 m. Tidal currents within the AfL area can reach an average speed of 3 m/s on a spring tide and 1.5 m/s on a neap tide.

There are a number of sites within 10 km of the AfL area designated as areas of national geological importance, including the adjacent Torr Head Area of Special Scientific Interest (ASSI) and the Fair Head and Murlough Bay ASSI. Hydrodynamic modelling of the Project area with and without the 100 turbine array has shown that the presence of the array creates a minor net reduction in current speeds where the turbines are dense, and very minor wake effect current speed reductions to the north-west and south-east of the array, extending to a maximum of 8 km from the AfL area. These changes in current speeds are not likely to bring about any changes to the surrounding beaches or cliff coastline. The release of drill cuttings during turbine support structure installation will be quickly dispersed in this high energy environment and cause only a temporary increase in suspended sediment concentrations. All impacts to physical processes and sediment dynamics were assessed to be not significant.

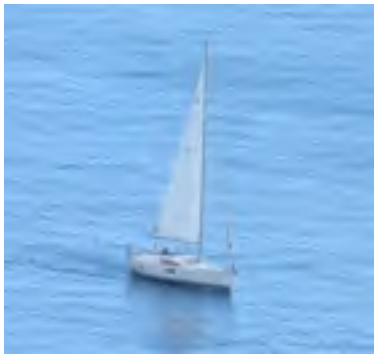
3.8 Marine archaeology & cultural heritage

The north coast of County Antrim has been identified as having high archaeological potential due to a number of shipwrecks that are known to have occurred within the area. There are no known shipwreck sites within the Project area. Although there are two recorded wrecking events in the AfL area and five recorded wrecking events within the export cable area of search, no shipwrecks or related significant archaeological material has been detected during any of the seabed surveys of the area. Due to the highly dynamic environment and hostile nature of the exposed bedrock located off Torr Head it is unlikely that any shipwreck in this location would remain intact for any length of time.

A series of anomalies have however been identified from the data collected during surveys, one of which relates to a sub-bottom profile target located outside the AfL area, which could potentially help to position-fix the twentieth-century wreck of the *Irishman*, which sank in 1925.

The potential for archaeological remains to exist will be confirmed as part of a geophysical survey of the Project area which will be carried out to inform detailed design and layout of the tidal array and associated cables. If archaeological remains do exist within the AfL area or export cable area of search there is potential that these could be directly impacted during installation of the Turbine Support Structures (TSSs), cables or by anchors from vessels involved in installation activities. However, the potential for these impacts to occur will be avoided or minimised through implementation of the proposed mitigation measures which are focused around the avoidance of known sites of archaeological importance during detailed design for TSS and cable layouts. If detailed archaeological investigation is required this will be carried out using a drop down camera or Remote Operated Vehicle (ROV). Strategies for any additional mitigation will be developed on a case by case basis in consultation with DoENI Marine Division, the Centre for Maritime Archaeology (CMA) and Northern Ireland Environment Agency (NIEA): Historic Monuments Unit (HMU). With the implementation of the described mitigation it can be concluded that any impacts on marine archaeology will not be significant.

3.9 Shipping and navigation



A Navigation Risk Assessment (NRA) was undertaken to identify risks to shipping and navigation in the Project area and surrounding waters. The NRA was carried out in line with the International Maritime Organisation (IMO's) Formal Safety Assessment (FSA) process and the DECC / Maritime and Coastguard Agency (MCA) guidelines for such assessments. Baseline navigational features and activities in the Project area were identified from a review of historic Automatic Identification System (AIS) data and maritime incident data and Project specific maritime traffic surveys. The maritime traffic surveys were carried out over two, 14 day periods, in winter and summer 2014 to record vessel activity in and around the Project area using AIS, radar and visual observations. This is consistent with the minimum of four weeks as specified in MCA Marine Guidance Note (MGN) 371.

Main ports in the vicinity of the Project area include Larne, Belfast and Coleraine. There are also a number of anchorage locations near to the Project area including Cushendun Bay, Red Bay, Carnlough Bay and Glenarm Bay to the south and Murlough Bay, Rathlin Island, Ballycastle, Ballintoy Harbour and White Park Bay to the west. The majority of vessels observed in the AfL area during the maritime traffic surveys were small fishing vessels and recreational yachts. There is a Traffic Separation Scheme (TSS) in place 1.5 nm to the north east of the AfL area. Tankers and other large vessels typically remain within this route.

A Hazard Review Workshop was held in September 2014 to identify hazards to shipping and navigation associated with the Project and to inform the assessment of shipping and navigation impacts. The workshop was attended by stakeholders representing various types of vessel activity and emergency response organisations in the local area.

The assessment identified a number of potential risks, such as transiting vessel collision with subsea devices and fishing interaction with subsea equipment. By applying standard industry practice and additional, project-specific mitigation identified during consultation and at the Hazard Review Workshop, all of the residual risks were assessed to be either broadly acceptable or tolerable (As Low As Reasonably Practical (ALARP) with mitigation).

Further liaison with regulators (Commissioner of Irish Lights (CIL) and MCA) and stakeholders is planned to ensure the appropriate and effective implementation of proposed mitigation e.g. safety zones. With appropriate mitigation all shipping and navigation impacts are assessed to be not significant.

3.10 Seascape, landscape and visual amenity

The Project is located off Torr Head on the North Antrim coast. The entire stretch of the North Antrim coast, and adjacent hinterlands, from Ballycastle in the west to Cushendun to the south is located within the Antrim Coast and Glens Area of Outstanding Natural Beauty (AONB) incorporating several Landscape Character Areas (LCAs) and Seascape Character Areas (SCAs). The Project area lies within the Torr Head Coast SCA. Key characteristics and features of the SCA include exposed headlands with crashing waves, sheltered bays, rocky outcrops and a strong sense of inaccessibility, remoteness and naturalness. Views from the coastal area immediately adjacent to the Project are dramatic with views of Scotland in the distance.

Although Torr Head, and a large proportion of the north Antrim Coast, is included within the Antrim Coast and Glens AONB and is considered to be of very high landscape and seascape importance, potential impacts from the offshore aspects of the Project on seascape, landscape and visual amenity are assessed to be not significant. This is on the basis that all permanent offshore components of the Project will be fully submerged (e.g. there will be no surface piercing devices or other infrastructure).

Where potential impacts have been identified these are mainly in relation to vessel presence during installation, maintenance and decommissioning. However, the assessment concluded that, due to the low number of vessels involved in these activities, the localised nature of potential impacts and existing vessel presence in the area, potential impacts on the landscape and seascape character and visual amenity of the Torr Head area and the wider AONB would not be significant.

Given that the tidal turbines will be fully submerged to a clearance depth of at least 8 m below the surface of the water it is highly unlikely that physical aids to navigation (lit navigational buoys) will be required to mark the location of the tidal array during operation. However, this is subject to further consultation with the CIL based on the results from the NRA. Should it be determined that lit navigational buoys are required the assessment concluded that these are not expected to have a significant impact on landscape or seascape character or views from Torr Head.

3.11 Socio-economics, tourism and recreation

The Project lies offshore of the Moyle Local Government District (LGD). With a population of approximately 17,050 people, the population of the Moyle LGD is the smallest of any LGD in Northern Ireland. The main population centres are Ballycastle, Cushendun and Cushendall. Employment within the Moyle LGD is mainly within the human health and social work, construction, wholesale and retail trade sectors. Agriculture, accommodation and food services sectors also account for a large proportion of local jobs.

Across Northern Ireland in terms of gross value added (GVA) public administration, education and health is of primary importance followed by distribution, transport, accommodation and food. There are also a number of prominent industries in the area which include marine engineering, construction and manufacturing. Tourism is also an important industry for the area with people visiting the Antrim Coast and Glens AONB where key activities include cycling, hiking and walking. Sea angling is the key recreational activity offshore with tope, pollack, coalfish, ballan wrasse and mackerel being targeted in the Torr Head area. Other offshore activities include diving and wildlife tours.

The Project has potential to generate significant positive impacts for both the Northern Ireland and the local labour force and supply chain. In particular there is a significant opportunity to establish a local Northern Ireland offshore renewable energy industry base through synergies with similar projects. This base would not only provide services for this Project but through continued development of the skills, knowledge, experience of individuals, firms and other stakeholders and building a strong supply chain, this will help attract future Project and additional investment to Northern Ireland. In addition, there is also the potential to create academic and scientific research opportunities relating to monitoring programmes and strategies that will be developed to monitor the effects of the Project on the environment.

Potential negative impacts may occur as a result of disruption to marine tourism activities (sea angling, sight-seeing from boats, diving), but these are concluded to be not significant, and there may be some economic opportunities generated by the Project for those involved in local marine tourism in terms of visitors to the area.

TVL understands the importance of community commitment initiatives, and supports the provision of direct community benefits from operating developments to local communities. It is TVL's intention to establish a community fund to benefit both the local residents and fishing communities.

3.12 Water and accidental events

Northern Ireland has over 650 km of coastline. The waters off this coastline support a wealth of biodiversity and are important sources of recreation and employment in particular with regard to fishing and shipping. Over recent years there have been significant decreases in the levels of contaminants in marine sediments. This is mainly as a result of improved practices, better environmental regulation and a decline in some of the most polluting historical industries. These reductions in levels of contaminants in marine sediments have had a positive effect on the environment in particular marine wildlife and shellfish. There are no known or potential areas of contamination within the Project area. There are also no designated shellfish waters in the Project area. The closest designated bathing water is at Ballycastle, approximately 11.5 km west of the AfL area.

An assessment has been carried out into the potential accidental and non-routine events that may occur as a result of the Project. It was concluded that, while there is potential for a pollution event to occur, either as a result of a fuel / oil spill from a vessel during installation or release of lubricants from the tidal turbines, the likelihood of these pollution events occurring is very low. With the implementation of recognised industry best practice mitigation measures and management plans the potential for these events to occur will be further reduced. In the unlikely case that a pollution event does occur, relevant management plans will be implemented immediately to ensure that potential impacts on the environment are minimised.

3.13 Other sea users

There is no existing oil and gas infrastructure, offshore wind farms or aggregate dredging located in the vicinity of the Project area. However, the Project is located within the Offshore Frontier Licence Block P1885 awarded to Providence Resources by DECC in 2012 as part of the UK's 26th Oil and Gas Licencing Round. A second licence application has been submitted to DECC under Petroleum Exploration Licences P2123. This licence application, which covers five blocks extending south from an area to the south of Torr Head is still under consideration.

In addition to the Torr Head AfL, two additional AfL areas were awarded for offshore renewable energy projects in Northern Ireland, the Fair Head Tidal Energy Array AfL area which is located approximately 4 km north west of the Torr Head AfL area and the First Flight Offshore Wind AfL area which is located off the coast of Kilkeel approximately 112 km south of the Torr Head AfL area. However, the First Flight Wind Project, is no longer being taken forward for development.

A number of subsea cables (electricity and telecommunications) pass north south through the North Channel and east west between Northern Ireland and Scotland. Closest to the Project area is the Rathlin Island Interconnector, which runs from Ballycastle to Rathlin Island, approximately 11 km from the AfL area. The Hibernia Atlantic telecommunications cable which is part of the Hibernia Atlantic telecommunications network passes within 13 km of the AfL. The AfL lies within military practice area X5528: Torr.

The assessment concluded that the Project will not have any significant impacts on other sea users. In terms of impacts on other sea users such as existing subsea cables and harbour dredge disposal sites, it was concluded that direct impacts are very unlikely to occur during any phase of the Project due to the distance between the AfL area and these users (closest sub-sea cable is approximately 11 km from the AfL area). All vessel providers will be notified of the presence of all existing and proposed (Fair Head Tidal Energy Array) subsea infrastructure in the area to reduce the risk of potential anchor strike.

The potential presence of migrated munitions (from the Beaufort's Dyke munitions dump located approximately 50 km south off the Project area of the coast of southwest Scotland) and unexploded ordnance (UXO) from historical military training exercises and legacies from two world wars will be confirmed as part of a geophysical survey that will be carried out to inform detailed design of the Project. Any UXO risk will be managed to ensure it is as low as reasonably possibly.

There is potential for restricted access to MOD military practice and exercise areas and oil and gas exploration areas during all phases of the Project. However, the area occupied by the Project is only 0.3 % of the Torr military practice and exercise area and less than 1% of the Frontier Licence Block P1885 oil and gas exploration area. Potential impacts of restricted access in these areas is considered to be not significant due to the small scale of the area affected. While, the MOD has indicated that no further consultation is required unless the Project changes significantly, TVL will continue to engage with Providence Resources in order to avoid any future conflict between the Project and oil and gas exploration activities in this location.

3.14 Potential onshore impacts

As noted in Section 1, due to uncertainties regarding the nature and location of the connection of the Project to the Northern Ireland national grid network, it has not been possible at this stage to progress the design of the onshore components of the Project in sufficient detail to carry out a full EIA covering the onshore and offshore components of the Project at the same time. However, as noted in Chapter 22 of the ES, there is sufficient information contained within the EIA Scoping Report and EIA Scoping Opinion and work completed on the onshore feasibility study carried out by Fehily Timoney & Company to identify potential impacts of the onshore components of the Project that are likely to require more detailed assessment as part of the onshore EIA.

The onshore components of the Project include the cable landfall (works above Mean Low Water Spring), onshore cable route and construction and operation of a local onshore substation. There will also be a requirement for temporary construction compounds and storage areas for equipment required for the onshore Project. There may also be a need to upgrade local roads or improve road junctions in certain locations in order for heavy plant and equipment to gain access to the landfall and / or local substation site.

Given that the onshore Project study area is located entirely within the Antrim Coast and Glens Area of Outstanding Natural Beauty (AONB) there is potential for components of the onshore Project such as construction activities at the landfall and local substation site, temporary access, construction compounds and storage areas

and the long term presence of the substation and road upgrades to have impact on the local landscape character and visual amenity of the area. Taking this into account, TVL will continue to work closely with a range of stakeholders to assess options for minimising potential impacts where possible through siting and detailed design to ensure that significant impacts do not occur. As part of the onshore EIA a full landscape and visual impact assessment will be carried out in accordance with the Landscape Institute and Institute of Environmental Management and Assessment (IEMA) Guidelines for Landscape and Visual Assessment (GLVIA), third edition (2013). The assessment will also take into account all relevant design and planning guidance for development in rural locations and AONBs.

With regard to potential impacts on other environmental receptors, most are likely to occur during the construction phase e.g. construction activities at the cable landfall, installation of the onshore cable, construction of the local substation and road upgrades (if required). Most of these potential impacts such as the generation of noise, dust and traffic disruption and the impact of these on the environment, local population and visitors will be short term and temporary in nature and are unlikely to be significant. However, these impacts will still be assessed in detail in order to confirm that significant impacts will not occur.

Where construction activities could have longer term impacts such as habitat loss or direct impacts on features of archaeological or cultural heritage importance desk studies and surveys may be required to determine the potential for significant impacts to occur. Consultation will also be carried as part of the assessment process and where necessary to inform the development of appropriate mitigation strategies which will be put in place to ensure that significant impacts do not occur.

In addition to the potential impacts on local landscape and visual amenity and the character of the AONB, potential longer term impacts on local land uses, material assets and local recreation and tourism in the area during operation of the substation will also be assessed.

TVL will continue to consult will all stakeholders throughout all phases of the Project to ensure that, where possible, key issues / concerns are addressed as part of the EIA process, and that potential impacts associated with the onshore components of the Project are kept to a minimum.

3.15 Cumulative and in-combination impacts

Cumulative and in-combination impacts have been considered throughout the EIA process and have been considered for all phases of the Project. A list of 40 other projects and other regulated activities (past, present and planned) to be considered as part of the Cumulative Impact Assessment (CIA) was agreed with DoENI Marine Division and DETI. These Projects included other offshore renewable energy projects (wave, tidal and offshore wind), interconnector and telecommunications cables, oil and gas projects and National Renewable Infrastructure Plan (NRIP) Projects.

The purpose of the CIA was to assess additive or incremental impacts resulting from changes caused by other Projects together with the planned Project and interactions between impacts of other projects. Although there are a number of other projects and activities occurring in the vicinity of the Project, the adjacent Fair Head Tidal (FHT) Energy Array was identified as having greatest potential for cumulative and in-combination impacts with regard to the offshore Project.

The CIA concluded that, for all EIA topics potential cumulative impacts resulting from the Fair Head Tidal Energy Array were considered to be not significant. This is mainly on the basis that, for a number of the EIA topics, the impacts from the Fair Head Tidal Energy Array, which is a similar 100 MW tidal array, are predicted to be similar to this Project due to similarities in the sensitivity / value of the different environmental receptors and scale and types of impacts that are likely to occur. Therefore, when the scale of each impact was taken into consideration, the overall cumulative impact of both projects was also considered to be not significant.

Based on information available at the time of completion of the EIA, the main difference between the two projects is the Fair Head Tidal Energy Array Project will comprise of devices with a minimum clearance from blade tip to the sea surface of 5 m at LAT and includes for the use of up to 12 surface piercing monopiles. Taking this into consideration, potential cumulative impacts relating to shipping and navigation and SLVIA are still predicted to be not significant.

Potential cumulative impacts on marine mammals due to an increased risk of collision with submerged turbines in both tidal arrays were assessed by increasing the number of turbines included in the encounter modelling undertaken for the TVL Project from 100 to 200 turbines. The results concluded that cumulative impacts on marine mammals due to increased risk of collision would not be significant.

Potential cumulative and in combination impacts with other onshore projects will be considered as part of the onshore Project EIA. This will include a review of operational, granted and proposed projects in the planning system. An initial review indicates that renewable projects currently in the planning system comprise of small scale, single and micro renewable projects e.g. single wind turbines and micro hydroelectric schemes. At this stage in the Project it is the intention that Fair Head Tidal (FHT) will utilise the same local substation as the Torr Head Tidal Energy Array Onshore Project therefore removing the potential for any cumulative impacts associated with the construction of two local substations.

The main source of potential cumulative impacts will be associated with activities at the two export cable landfall locations and installation of the onshore cables for both projects. Impacts associated with these activities will be assessed in more detail as part of the onshore EIA but are likely to include temporary and short term impacts relating to noise, dust and traffic disruption, localised impacts on terrestrial ecology, archaeology and possible landscape and visual impacts.

Potential cumulative impacts associated with the offshore components of the Project are expected to be minimal, with the main potential receptors being seascape, landscape and visual amenity, ornithology, local recreation and tourism. However, given that the offshore EIA has concluded that there would be no significant impacts on any of these receptors, the potential for cumulative impacts with the onshore components of the Project are also likely to be minimal and not significant. However, these will be subject to more detailed assessment as part of the onshore EIA to ensure that this remains the case.

3.16 Wildlife licences

For marine species protected under either the Conservation (Natural Habitats, etc.) Regulations (Northern Ireland) 1995 (as amended) e.g. whales, dolphins, porpoise and seals, and / or the Wildlife (Northern Ireland) Order 1985 (basking shark and seals) it is an offence to deliberately or recklessly kill, harm or disturb any of these species. Deliberate harm to any of these species is not anticipated as part of the Project. However, inadvertent or accidental disturbance may occur if Project activities take place in the presence of these species. Requirements for a Wildlife Licence with regard to potential disturbance to any of these species during all stages of the Project will be discussed through consultation with the DoENI Marine Division.

4 ENVIRONMENTAL MANAGEMENT

4.1.1 Environmental Management Plan (EMP)

EIA, including consultation with stakeholders, is an iterative process that will continue beyond ES submission. The primary mechanism for ensuring that the environmental assessment continues and that all environmental issues are addressed throughout the lifetime of the Project is through the Project Environmental Management Plan (EMP) which will be implemented as part of the overall Operational Management System for the Project.

The EMP will provide the overarching framework for on-site environmental management for the protection of environmental interests. It will be a working document which details consent conditions, the commitments outlined in the ES and compliance monitoring requirements. It will also highlight the parties that are responsible for the implementation of the contents of the EMP.

The EMP will be developed and implemented in agreement with the relevant stakeholders, including the DoENI Marine Division and their statutory advisors following a successful award of Project consents. This is necessary to ensure that all ES mitigation commitments, consent conditions and environmental monitoring requirements are implemented as required.

4.1.2 Mitigation

The potential impacts of the Torr Head Tidal Energy Array Project have been assessed through the EIA and NRA processes and the results of the impact assessment presented in the ES (and accompanying NRA). These processes have indicated it is necessary to manage certain aspects of the Project to ensure potential impacts are not significant. Some of the key mitigation measures that have been identified include:

> Standard industry practice with regard to the management and mitigation of shipping and navigation activities will be followed in addition to Project specific mitigation (enhanced), the specific details of which will be agreed as part of ongoing consultation with the MCA, CIL and other navigational stakeholders. This includes consideration for the implementation of safety zones during installation of the turbines, virtual aids to navigation, inclusion of the tidal array on Admiralty Charts for the area and consultation with other sea users on navigational restrictions through Notices to Mariners, provision of information at local ports and harbours and updates to sailing charts and almanacs;

> Throughout the Project, TVL will continue to liaise with the local fishing community through the Project FLO in accordance with the FLOWW Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison (January 2014). In order to reduce the potential for significant impacts on local fishermen, TVL plans to work with all those involved in the fishing industry to ensure minimal impact to anyone working in the area. Where genuine financial loss can be demonstrated compensation will be considered on the basis of factually accurate and justifiable claims. TVL also plans to establish a community fund to benefit both the local community and people involved in the local fishing industry;

> Although new evidence suggests the main cause of corkscrew injuries to seals are by seals themselves, impacts from vessels cannot be ruled out. TVL will undertake frequent reviews of new research and guidance and undertake further consultation with DoENI Marine Division and other nature conservation stakeholders with regards to these potential impacts. TVL will also continue to liaise with DoENI Marine Division on measures required to mitigate potential impacts on benthic habitats and species resulting from the introduction of Marine Non-Native Species (MNNS).

> To inform detailed design of the tidal array, TVL will carry out a geophysical survey of the Project area. Information from this survey will be used to carry out a more detailed examination of possible marine archaeology anomalies identified in the Project area. To further minimise any potential impacts on any potential sites or features of marine archaeological importance, TVL in, consultation with DoENI Marine Division, NIEA:NH and other relevant stakeholders will prepare a mitigation strategy and reporting protocol which will set out a series of staged steps for the avoidance, investigation and, if required, reporting of archaeological remains that could be impacted by the Project; and

> Emergency response plans will be prepared for the Project in accordance with relevant guidance setting out measures to reduce risk of, and manage potential impacts from, any accidental fuels spills from vessels involved in the installation of the Project or leakage of lubricants from the turbines.

4.1.3 Environmental Monitoring Strategy (EMS)

Due to the emerging and ever evolving nature of the tidal energy industry there are some potential impacts that have yet to be verified by operational monitoring in the industry. As part of the EIA, TVL has made use of available data from the monitoring of single turbines e.g. post installation monitoring studies carried for turbines installed at the European Marine Energy Centre (EMEC) and at the Fundy Open Research Centre for Energy (FORCE). However, TVL recognises that there is still little data currently available and its application to the assessment of tidal arrays is limited.

TVL has identified that individual developers do not have access to adequate resources to address all known data gaps and uncertainties. This situation means that TVL has identified two approaches to monitoring:

> Where TVL identifies monitoring requirements for the Project, specific issue monitoring protocols will be developed in consultation with the regulators and their advisors; and

> Where uncertainties in the assessment are identified that are considered of strategic importance to the development of the tidal energy industry, TVL would wish to engage with the wider industry, regulators, their advisors and stakeholders through involvement on working groups or similar forums in order to assist with developing strategic monitoring programmes for the benefit of future projects in Northern Ireland and elsewhere in the UK. For example OpenHydro sits on the Pentland Firth and Orkney Waters (PFOW) Developers Forum and would be interested in having a similar role as part of a Northern Ireland Working Group that would involve developers, regulators and other key stakeholders.

Overview of monitoring carried out for test / demonstration projects

At the time of ES submission, OpenHydro had deployed tidal turbines in three locations including seven iterations of the OpenCentre design at a platform at EMEC, Orkney, one at Paimpol Brehat in France, and one at the FORCE test facility, in the Bay of Fundy, Nova Scotia. As part of these deployments various post installation monitoring studies have been undertaken in order to develop a better understanding of the interactions between the turbines and the marine environment in which they are located. These monitoring studies include:

> Benthic monitoring in the Bay of Fundy and a small scale study looking at spatial and temporal benthic species assemblage responses with a deployed marine tidal energy device (Broadhurst and Orme, 2014);

> An observational pilot study looking at in-situ ecological interactions with a deployed tidal energy device (Broadhurst *et al.,* 2014); and

> Development of a marine mammal monitoring programme and killer whale monitoring, operation and protection plan in the Puget Sound, Seattle.

Proposed monitoring for the Torr Head Tidal Energy Array Project

Although no significant impacts were identified for marine mammals, there is still a level of uncertainty surrounding interactions between marine mammals and tidal turbines. TVL recognises the importance of monitoring marine mammal interactions with tidal devices not only to confirm the predictions that there would be no significant impacts but also to help increase knowledge and understanding of these interactions in order to help inform the continuing development of the tidal energy Projects worldwide.

TVL is therefore committed to developing an adaptive marine mammal monitoring programme, the details of which will be developed in consultation with the regulator (DoENI Marine Division) and other relevant stakeholders to ensure the programme is appropriate, practical and in line with best industry practice. Options for monitoring interactions between fish and tidal devices will also be considered for inclusion within this adaptive monitoring programme. TVL is also committed to collecting underwater noise measurements from the selected tidal turbines. The data collected will be used to validate the underwater noise modelling completed to inform the impact assessment.