Decommissioning of the SeaGen tidal turbine in Strangford Lough, Northern Ireland: Environmental Statement

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Decommissioning of the SeaGen tidal turbine in Strangford Lough, Northern Ireland: Environmental Statement

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Executive Summary

The SeaGen tidal turbine was installed in Strangford Narrow, Strangford Lough, Northern Ireland by Marine Current Turbines Ltd (MCT) in 2008 in order to study tidal energy technology through the investigation of engineering, management systems, and environmental impacts.

The SeaGen device consists of two 16 m diameter rotors and generators supported on a crossbeam that is affixed to a central tubular structure with a control unit on top. The device is secured in position using a quadropod foundation fixed on the seabed using drilled pin piles approximately 1 m diameter, 14 m long, and drilled to a depth of approximately 9 m. Each of the quadropod legs is hollow and contains grout and concrete.

MCT was acquired by Atlantis Resources Limited (Atlantis) from Siemens on the 01 July 2015. SeaGen is owned and operated through Sea Generation Ltd. (SGL), a wholly owned subsidiary of MCT, which in turn is now owned by Atlantis. SeaGen is now considered to have served its R&D purpose and Atlantis has taken the decision to decommission the device.

An Environmental Impact Assessment (EIA) was undertaken by Royal Haskoning DHV and completed in June 2005 with the production of an Environmental Statement (ES). The scope of the pre-construction EIA included construction, operation and decommissioning of the device. The decommissioning methods identified in 2005 ES were based upon assumptions concerning the likely methods that would be employed to decommission SeaGen.

An extensive Environmental Monitoring Plan (EMP) was established in order to fulfil the requirements of the conditional Food and Environmental Protection Act (FEPA) marine construction licence. Data collection for the EMP began in 2005 and continued until 2011 when the EMP ceased, SeaGen continued operating until Q4 2015. As part of the EMP, a focused Science Group and a wider Liaison Group were established in order to direct the environmental monitoring undertaken and as a way of reporting the findings to a wider group of stakeholders respectively. Overall, the findings of the EMP provided evidence that SeaGen operated with no likely significant impacts on the marine environment in Strangford Lough.

In 2011, a report produced for MCT by MOJO Maritime Ltd reviewed the potential methods to decommission the SeaGen tidal device. Since 2005, when the pre-construction EIA was undertaken, the range of decommissioning methods has expanded beyond that which was originally considered. As such, further EIA was required in order to cover contemporary decommissioning methodologies not assessed in the pre-construction EIA.

MarineSpace Ltd has been commissioned to prepare an additional EIA to include the decommissioning methods not covered previously. Data used to inform the decommissioning EIA is based upon the evidence gathered during the EMP since the pre-construction EIA.

A scoping study was undertaken by MarineSpace Ltd to identify the key concerns and to consider the revised decommissioning methods. The SeaGen Decommissioning Scoping Report underwent a formal consultation in June 2016 to inform the potential impact pathways that are assessed in the EIA and presented in this Decommissioning ES.

A summary assessment of the residual impacts after appropriate mitigation has been put in place is given below:

- Loss or damage of benthic habitat via use of jack-up or moored barges is assessed to be negligible;
- Loss of designated seabed habitat (Strangford Lough Special Area of Conservation (SAC) and Marine Conservation Zone (MCZ)) via use of jack-up or moored barges is assessed to be negligible;
- Noise and vibration disturbance to fish resources via use of diamond wire cutting tool (DWCT) or abrasive water jet (AWJ) is assessed to be negligible;
- Noise and vibration disturbance to basking shark via use of jack-up or moored barge or DWCT or AWJ is assessed to be negligible;
- Underwater noise disturbance to marine mammals via use of Brocotorch, DWCT, AWJ and vessel noise is assessed to be negligible;
- Collision between marine mammals and vessels involved in the decommissioning work is assessed to be negligible; and
- Obstruction to movement of fishing vessels through use of jack-up or moored barges is assessed to be negligible.

A summary of mitigation measures proposed to minimise the risk of impacts is given below:

- Decommissioning will not take place during common seal pupping season (May to August);
- Undertake decommissioning operations between January and March when abundance of marine mammals is low in order to reduce risk of potential noise disturbance to marine mammals;
- Undertake decommissioning operations between January and March when abundance of marine mammals is low in order to reduce the risk of collision with decommissioning equipment. Maximum vessel speeds to be implemented;
- Reduce potential spread of non-native species through decommissioning activities via DWCT or AWJ; and
- Undertake decommissioning operations between January and March when there is no larval recruitment of *Didemnum vexillum* in order to reduce the potential risk of introduction of non-native species. No ballast water will be exchanged or discharged within 3 nm of the entrance of the Narrows. <u>No colonies of *Didemnum vexillum* have been observed on the SeaGen structure throughout operation and in preparation of the site for decommissioning.</u>

Overall, the potential environmental impacts as a result of decommissioning of the SeaGen device have been assessed as follows:

- Short-term and temporary impacts upon benthic communities in Strangford Lough via loss or damage of seabed habitat through use of moored barge or jack-up vessel;
- No adverse effect on site integrity of Strangford Lough SAC and less than 0.01% will experience short-term temporary impacts via loss or damage of designated seabed habitat through use of moored barge or jack-up vessel;
- Short-term and temporary impacts upon fish, including basking shark, pinnipeds and cetaceans, due to noise disturbance through use of DWCT or AWJ;
- Impacts on all other receptors are considered to be negligible;
- No cumulative impacts with commercial fisheries, shipping and the Minesto tidal device; and
- Decommissioning of the SeaGen device is not predicted to result in any medium to long-term environmental impacts.

It is the conclusion of the EIA that following mitigation there will be no major adverse residual impacts either from the project alone or cumulatively with other projects on any environmental receptors within Strangford Lough.

Information has also been provided within the ES to facilitate HRA for the possible impacts of the project upon the nature conservation features of Strangford Lough. It is predicted that the project alone, and in combination with other plans and projects, will result in no likely significant effect on the European sites of Strangford Lough.

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Acronyms

AWJC	Abrasive Water Jet Cutting
CB	Cargo Barge
CBD	Convention on Biological Diversity
DPHLV	Dynamic Positioning Heavy Lift Vessel
DWCT	Diamond Wire Cutting Tool
EIA	Environmental Impact Assessment
EMP	Environmental Monitoring Programme
ES	Environmental Statement
FEPA	Food and Environment Protection Act
HDD	Horizontal Directional Drilling
HLV	Heavy Lift Vessel
HRA	Habitats Regulations Assessment
IAS	Invasive Alien Species
IFCA	Inshore Fisheries and Conservation Agency
JNCC	Joint Nature Conservation Committee
JUP	Jack Up Platform
MB	Moored Barge
MCT	Marine Current Turbine Ltd
MHLV	Moored Heavy Lifting Vessel
MMO	Marine Management Organisation
NNR	National Nature Reserve
OCV	Offshore Construction Vessel
OWF	Offshore Wind Farm
QUB	Queen's University Belfast
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SMRU	Sea Mammal Research Unit
SPA	Special Protection Area
UKHO	UK Hydrographic Office
WB	Workboat

1. Introduction

1.1. Background

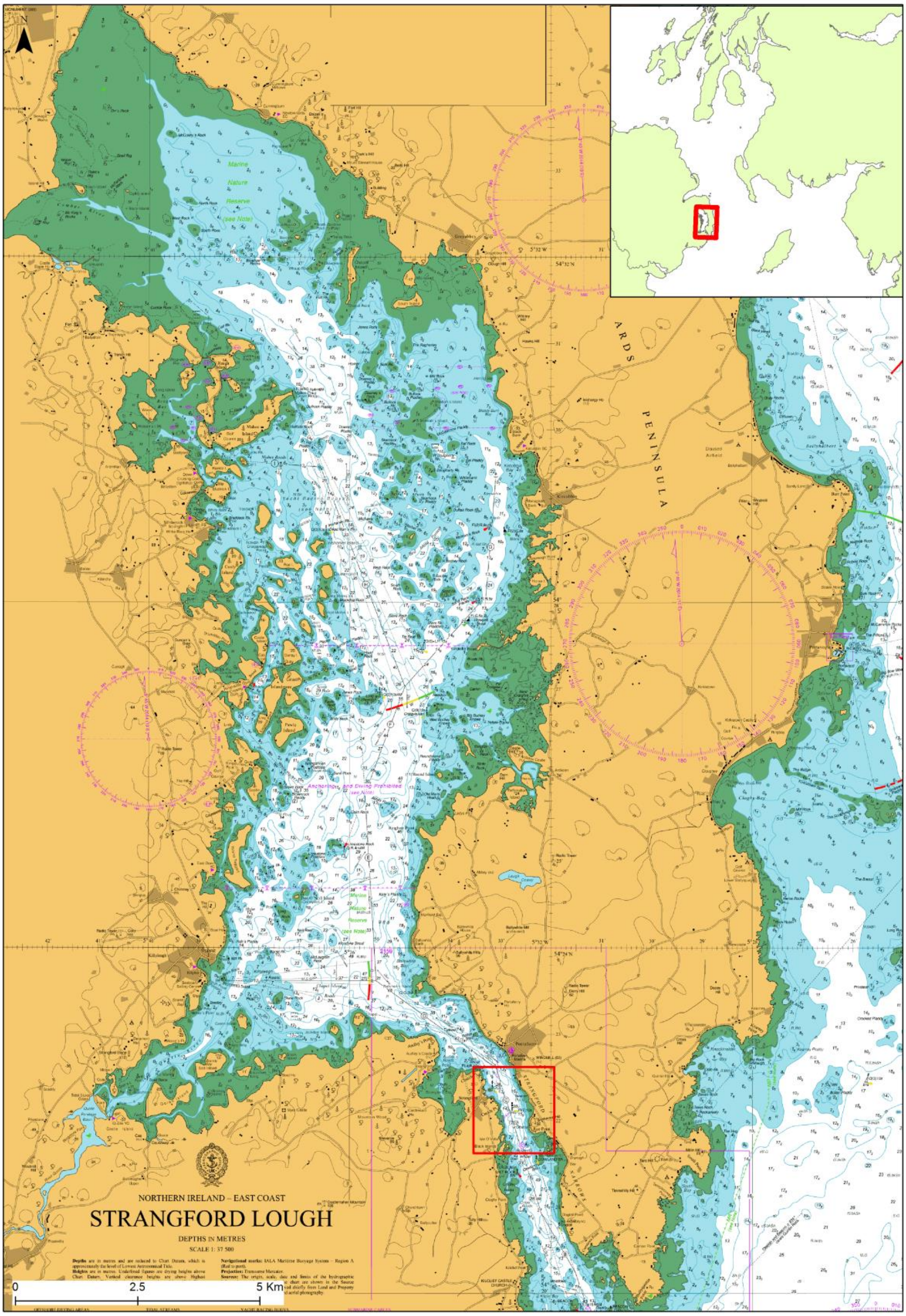
SeaGen was installed in 2008 in Strangford Narrow, Strangford Lough, Northern Ireland by Marine Current Turbines Ltd (MCT) in order to study tidal energy technology through the investigation of engineering, management systems, and environmental impacts. Data and experience gathered from SeaGen's operation has facilitated the development of the SeaGen 1MW power train and furthered the understanding of the environmental impacts of tidal technology upon the marine environment.

MCT was acquired by Atlantis Resources Limited (Atlantis) from Siemens on the 01 July 2015. SeaGen is owned and operated through SeaGeneration Ltd. (SGL), a wholly owned subsidiary of MCT, which in turn is now owned by Atlantis. The SeaGen device is now considered to have served its R&D purpose and Atlantis has taken the decision to decommission SeaGen.

SeaGen is located in Strangford Narrows, approximately 1 km south of the ferry route between Strangford and Portaferry, and around 400 m from the shoreline (Figure 1.1).

Strangford Lough is a shallow sea lough and is one of the largest sea loughs in Ireland, being approximately 150 km^2 (Brown, 1990). The lough is connected to the open sea by an 8 km long channel called the Narrows.

Figure 1.1: Location of the SeaGen tidal device in Strangford Narrows, Strangford Lough



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The SeaGen device consisted of two 16 m diameter rotors and powertrains supported on a crossbeam that is affixed to a central tubular structure with a control unit on top. The rotors and powertrains were removed in May 2016. The device is secured in position using a quadropod foundation fixed on the seabed using drilled pin piles approximately 1 m diameter, 14 m long, and drilled to a depth of approximately 9 m (Figure 1.2). Each of the quadropod legs contains grout and concrete.

SeaGen has been in operation since 2008 and is planned to be decommissioned in Q1 2017. A full EIA was undertaken prior to installation, covering construction, operation and decommissioning operation (Royal Haskoning, 2005; Appendix A). Since installation, the methods that are being considered for decommissioning have evolved and are no longer covered by the scope of the pre-construction EIA (Atlantis, 2016; Appendix B). This Environmental Statement (ES) considers the potential environmental impacts that may arise from the decommissioning procedures under consideration. This ES does not aim to duplicate what was presented in the pre-construction EIA and impacts will only be assessed where changes in decommissioning methods have had a material change on the likelihood of an impact on the environment.

The specific impacts that were assessed within this document were identified in the SeaGen Decommissioning Scoping Report (MarineSpace, 2016; Appendix C), which underwent formal consultation in June 2016. Receptors and impact pathways that were considered unlikely to be affected were scoped out within the scoping document. A record of the consultation responses and corresponding actions are presented in Appendix D.

Figure 1.2: SeaGen Device in Strangford Lough with Powertrains Removed (From: SeaGen, 2016)

2. Consents and Licensing

2.1. Marine Licence

At the time of consenting for the SeaGen project, deposits in the sea were controlled under the Food and Environment Protection Act, 1985, Part II, Deposits in the Sea (FEPA). A conditional FEPA marine construction licence was issued to MCT on 15 December 2005 based on responses from consultation and requirements of EU Directives and Northern Ireland environmental legislation.

There have been subsequent variations to the marine licence that have taken into account the scientific knowledge built up through the ongoing monitoring programme and the adaptive management approach adopted by MCT.

As a condition of the FEPA licence, a detailed Environmental Monitoring Programme (EMP) was established. Data collection began in April 2005 and the final report presenting analysis of all the monitoring data was delivered in 2011 (Royal Haskoning, 2011). Overall, the findings of the EMP provide evidence that SeaGen operated with no likely significant impacts on the marine environment in Strangford Lough.

Two formal groups were established: a Science Group to advise on development of the EMP, and a Liaison Group to whom progress and decisions would be reported. Both Science and Liaison groups have operated since 2006 and have been engaged in the decommissioning process to ensure continuity as the Decommissioning Working Group and Liaison Group respectively.

2.2. Environmental Impact Assessment

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

The EIA procedure is a means of drawing together an assessment of a project's likely significant effects on the local environment. This approach helps ensure that the importance of predicted effects, and the scope for reducing them, are properly understood by the public and the relevant competent authorities before a decision is made.

Given the unique nature of the SeaGen device, a full EIA was undertaken to investigate and establish possible impacts of the installation, operation and decommissioning processes and suitable mitigation measures and completed with the production of an ES (Royal Haskoning, 2005). This current document (the Decommissioning ES) supplements the pre-construction ES by providing up to date information in relation to the decommissioning methods and evidence from monitoring of construction and operation of the device.

2.3. Habitats Regulations Appraisal

The Conservation (Natural Habitats, & c.) Regulations (Northern Ireland) 1994 require that certain plans that are likely to have a significant effect on a 'Natura 2000' site must be subject to an appropriate assessment by the plan-making authority. The process for determining whether an appropriate assessment is required, together with the appropriate assessment itself is known as 'Habitats Regulations Assessment'. Natura 2000 is the Europe-wide network of protected sites developed under the European Commission Habitats Directive (Directive 92/43/EEC) and the Birds Directive (79/409/EEC) and comprising Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

A Habitats Regulations Assessment (HRA) may also need to be considered as part of the decommissioning process. This document contains the relevant information required to inform an HRA, and this will be identified within the text, where applicable.

2.4. Navigational Impact Assessment

A navigational impact assessment developed by Marico Marine Ltd (2016) has been provided as Appendix E to this ES.

The assessment considered two possible decommissioning methods as dictated by vessel type:

1. Use of a jack-up vessel;
2. Use of a moored vessel or barge; and
3. Dynamic positioning vessel.

Analysis of the decommissioning methodology was undertaken to identify hazards to passing vessels, and along with stakeholder consultation and data analysis representative hazard logs were created. Based on this the following hazard categories were identified – collision, contact, grounding and breakout.

The results of the impact assessment show that the navigation risk to passing vessels increases as a result of the decommissioning operation, however, all navigation hazards can be reduced to acceptable levels if the following additional risk controls are implemented (in addition to those risk controls already embedded in international and nation legislation):

- Provision of a safety boat;
- Weather, visibility & tidal limitations on mooring operations;
- Lights and marking;
- Promulgation of Information;
- Restrictions to fishing in the area;
- 50m Safety Buffer Zone; and
- Tug attendance.

The exact details of these risk controls and their operation will be considered by the chosen decommissioning contractor, documented in the method statement, and promulgated through consultation with the local navigation stakeholders and regulatory authority prior to commencement of the decommissioning activities.

3. Methodology

Prior to construction of the SeaGen tidal device, Royal Haskoning DHV conducted an environmental scoping exercise and full pre-construction EIA which considered the proposed construction, installation and operation of the device and decommissioning operations based on the best available evidence at the time (Royal Haskoning, 2005).

Atlantis issued a request for information (RfI) to understand the various methodologies and vessels that contractors proposed to use to decommission the device. The RfI process demonstrated that the range of decommissioning methods being considered was wider than the original assessment envelope (Atlantis, 2016). The EIA process followed here does not repeat the assessments carried out in the pre-construction EIA, but covers any changes in potential decommissioning methods that were outside the scope of pre-construction EIA and which changed the likelihood of potential environmental impacts.

3.1. Scoping Document

An initial scoping study was undertaken by MarineSpace to identify the key concerns outstanding from the original pre-construction ES and to consider the revised decommissioning methods. The SeaGen Decommissioning Scoping Report (MarineSpace, 2016) underwent a formal consultation in June 2016 to inform the potential impact pathways that were assessed in the EIA and presented in the ES. Agreement was reached with key regulators during the scoping stage on which potential impact interactions to scope out.

A full summary of the findings of the scoping document is presented in Section 5, including all receptors and impacts that were scoped in and out of the EIA. The receptors and impact pathways where there is potential for impact and considered within this EIA are presented in Table 3.1.

Table 3.1: Summary of impacts scoped in to be assessed in the EIA

Receptor	Impact
Benthic habitat and species	Loss or damage of benthic habitat within the Narrows during decommissioning
	Damage to other benthic SAC features during decommissioning
Fish	Disturbance due to noise and vibration
	Impact on basking shark through noise disturbance
Marine mammals	Noise disturbance and injury
	Collision with decommissioning vessels
Ecology	Introduction of non-native invasive species
Human environment	Navigation
	Obstruction to movement of commercial fisheries
	Above-sea noise levels

3.2. Impact Assessment

3.2.1. Methodology for Impact Assessment

The EIA was carried out based on project information supplied by Atlantis, and from stakeholder engagement and statutory consultation responses to the SeaGen Decommissioning Scoping Report. The EIA was undertaken based on current best practice and guidance, which were predominately developed for offshore renewable projects but are applicable to this project:

- IEEM (2010). Guidelines for Ecological Impact Assessment in Britain and Ireland. Marine and Coastal. Final Document. Institute of Ecology and Environmental Management; and
- Cefas (2004) Offshore Wind Farms. Guidance note for EIA in respect of FEPA and CPA requirements. Version 2. Available from: http://www.cefas.co.uk/publications/files/windfarm-guidance.pdf

The following EIA process was followed, including the scoping which is presented in a separate report (MarineSpace, 2016; Appendix B):

1. Scoping – to identify and assess key environmental impacts and issues of concern, facilitated by consultation with statutory and non-statutory consultees, non-governmental organisations (NGOs) and the public, to be considered in detail during the EIA;
2. Baseline studies – a desk study to identify and gather information required for the EIA;
3. Evaluation of alternatives – to identify and evaluate realistic alternatives;
4. Design mitigation – to identify how impacts can be avoided or reduced;
5. Project definition – to identify the Rochdale Envelope with SGL;
6. Environmental report production – produce an ES or environmental report;
7. Internal review – quality assurance and sign-off;
8. Submission and consenting – report submitted with application;
9. Implementation – put EIA recommendations into practice; and
10. Monitoring and audit (if required).

Formal consultation on the SeaGen Decommissioning Scoping Report took place with organisations and stakeholders that have an interest in the local area.

Collection of baseline data was from existing literature including the previous environmental scoping study (Royal Haskoning, 2004), ES (Royal Haskoning, 2005), environmental monitoring reports (Royal Haskoning, 2011) and updated decommissioning procedure (Atlantis, 2016), as well as specialist studies where necessary.

A Rochdale Envelope[1] approach was used within the EIA to consider the range of decommissioning methodologies outlined in the SeaGen Decommissioning Options Report (Atlantis, 2016). Under this

[1] Based on two UK planning law cases: 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].

approach, the project was broadly described and assessed within a range of defined criteria (an "envelope"). This approach allowed for flexibility in determining the final decommissioning details, while still meeting the requirements of the EIA.

The impact assessment considered the worst case elements of each decommissioning procedure in relation to the relevant receptors to ensure the impact assessment was appropriately conservative in accordance with a Rochdale Envelope approach.

As a result of the EIA, mitigation measures are recommended in order to provide solutions for any predicted adverse impacts, which may involve measures such as the restriction of works at certain times of the year.

Each impact was considered using the following criteria:

- Extent and magnitude of the impact:
    - Nature – direct or indirect; reversible or irreversible;
    - Duration – whether the impact is short, medium, or long-term, or permanent; and
- Sensitivity – the capacity of the receptor to accommodate the change.

The final significance of the impact – prior to the implementation of mitigation measures – was estimated by combining the magnitude of the impact and the sensitivity of the receptor. A summary of the outcomes of impact assessment can be seen in Table 3.2.

Table 3.2: The level of significance of an impact resulting from the combination of sensitivity and magnitude

Sensitivity	Magnitude			
	High	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Minor	Negligible	Negligible

The nature of predicted impacts has been identified and described within this document using the following terms, where appropriate:

- Beneficial or adverse;
- Short, medium or long-term;
- Permanent or temporary; and
- Reversible or irreversible.

The overall impact of the pathway was then assessed using expert judgement, and the following categories were applied:

- Negligible/no impact;

- Minor;
- Moderate; and
- Major.

3.2.2. Cumulative Impacts

Cumulative impacts on certain receptors may also arise via this decommissioning project interacting with other activities in the region. The potential for such cumulative impacts with other foreseeable projects and activities were assessed as part of this EIA.

Where projects were already in existence they were deemed to be part of the existing environment, contributing to the baseline conditions and were therefore not considered to provide a further cumulative impact.

3.2.3. Habitats Regulations Assessment (HRA)

Due to the potential for the SeaGen decommissioning procedures to impact upon the Strangford Lough SAC, a Habitats Regulations Assessment (HRA) may need to be conducted. This ES presents information that can be used to inform a HRA. Section 15 contains a summary of the relevant information that can be used to inform the HRA as well as advice on the likely outcome of the HRA.

In-combination impacts may arise from a combination of other plans and projects in the area. The proximity, nature and timing of work would need to be considered in the assessment of in-combination impacts. Other activities are likely to include existing marine activities, such as commercial fishing. Any current or future foreseeable plans and projects within the Strangford Lough area were considered as part of the in-combination impact assessment.

3.3. Objectives of the Environmental Statement

MarineSpace was commissioned by Atlantis to produce a full ES to accompany applications for the relevant consents for the decommissioning of the SeaGen device.

The objective of this ES was therefore to:

- Provide information on the baseline environmental conditions within Strangford Lough;
- Assess the environmental impact of the decommissioning process on the various receptors identified within the SeaGen Decommissioning Scoping Report;
- Recommend any mitigation that may be required to reduce potential impacts that should be undertaken during the decommissioning process;
- Assess the environmental impact of the decommissioning process on nature conservation features within Strangford Lough;
- Provide sufficient evidence to facilitate an HRA for the possible impacts upon the nature conservation features within the Strangford Lough area; and
- Set out a timetable for the decommissioning works.

4. Description of the Proposed Decommissioning Approaches

The SeaGen Decommissioning Options Report (Atlantis, 2016) communicates the engineering solutions that could be used to decommission the SeaGen device whilst ensuring consideration for safety and potential hazards.

SGL is currently working to identify a suitable contractor to conduct the decommissioning works. The decommissioning options report presents a range of potential engineering solutions that could be employed to decommission SeaGen.

A request for information that was recently issued to potential contractors has refined the vessels and methods proposed to decommission SeaGen, which are summarised in Section 4.2.

4.1. Decommissioning Approach

The decommissioning works is a two-phase process:

Phase 1 - Removal of powertrains and rotors: These works were completed in May 2016, leaving the cross beam and the superstructure and foundations in-situ. The crossbeam was returned to its operational position following powertrain and rotor removal.

Phase 2 - Removal of SeaGen superstructure and substructure: This work will incorporate removal of the remaining superstructure and substructure (to a pre-defined height above the seabed).

This ES considers Phase 2 of the decommissioning process only, and will consider the spectrum of decommissioning which will range from:

- Approach 1: Cutting and recovery of the SeaGen device in discrete sections; to
- Approach 2: Cutting of the quadropod pins piles and recovery of SeaGen as a single entity.

Atlantis have invited decommissioning contractors to submit proposals for the decommissioning works, through a Request for Quotation (RfQ) process, which will provide details their proposed cutting methodology and vessel strategy. The final decommissioning methodology and vessel spread will not be confirmed until the RfQ process is finalised in Q4 2016.

Table 4.1: Decommissioning Approaches 1 and 2

Approach 1 (in stages)
1. Disconnection of subsea cable
2. Cutting, removal and recovery of cross beam lift legs
3. Removal and recovery of pod
4. Cutting, removal, and recovery of cross beam
5. Removal and recovery of inverter and transformer from inside superstructure
6. Cutting and recovery of superstructure
7. Post-decommissioning survey
Approach 2 (as a single entity)
1. Disconnection subsea cable
2. Cutting quadropod and recovery entire structure
3. Removal and recovery of entire structure
4. Post-decommissioning survey

4.2. Decommissioning Cutting Methods and Vessels

In July 2016, Atlantis issued a RfI to potential contractors who were sufficiently qualified and experienced to undertake the decommissioning operations. The RfI process has ruled out a number of methods identified in the SeaGen Decommissioning Options Report. Based on the updated information from contractors engaged with SGL, the vessels and cutting options that are now under consideration to decommission SeaGen are shown in Table 4.2.

Table 4.2: Finalised decommissioning methodologies

Vessel Options	Cutting Options
• Jack-up vessel • Moored crane barges • DP vessel • Work boat	• Abrasive Water Jet Cutting • Diamond wire cutting • Thermic lance (Brocotorch)

The reduction in vessel and cutting options has resulted in a reduction in the scope of the impact assessments included in this ES when compared to the options covered in the SeaGen Decommissioning Scoping Report (Atlantis, 2016).

4.3. Cutting Methods

The SeaGen Decommissioning Options Report identified several possible engineering solutions (Atlantis, 2016).

Within the SeaGen Decommissioning Options Report, cutting options were assessed based upon:

- Ability to be deployed by divers / ROV;
- Performance in a tidal race;

- Environmental impact;
- Effectiveness;
- Sensitivity (to non-oval tubulars etc.);
- Cut location in relation to seabed level;
- Available access and egress to cutting location (including the quadropod piles);
- Duration of cutting operations;
- Cut quality;
- Likely weather window available;
- Size and complexity of equipment;
- Cost; and
- Legislative restrictions.

4.3.1. Shaped Charges

Whilst the use of shaped charges as a decommissioning methodology was considered within the SeaGen Decommissioning Scoping Report, further investigation has demonstrated that shaped charges will not be considered as a main cutting technique. Therefore, including shaped charges in the ES would skew the assessment of the preferred cutting options: diamond wire cutting (DWC) and abrasive water jet cutting (AWJC).

Should shaped charges be re-introduced at a later date then they will be addressed in a variation to the ES.

4.3.2. Decommissioning Envelope

The preferred cutting location would be through the pin piles above the SeaGen feet (Figure 4.1; Figure 4.2) leaving four foot in-situ. This cutting location has been agreed with the Decommissioning Working Group as the most preferable cutting location due to the environmental damage associated with removing the feet to the level of the seabed. However, until the final decommissioning procedure has been confirmed by the preferred contractor consideration will also be given to cutting through the main central pile.

As the seabed in this area contains a number of rocks and boulders, the presence of the feet will not increase the height of the seabed in the vicinity of the feet. The cutting method selected must be effective in the high current velocities experienced in Strangford Narrows.

The decommissioning procedure preferred by Atlantis will be to leave the export cable within the horizontal drilled hole, cutting the cable as close as possible to the borehole exits.

Figure 4.1: Image showing the estimated area where the SeaGen feet will be cut. The preferred cutting location is represented by the yellow line (SGL, 2016)

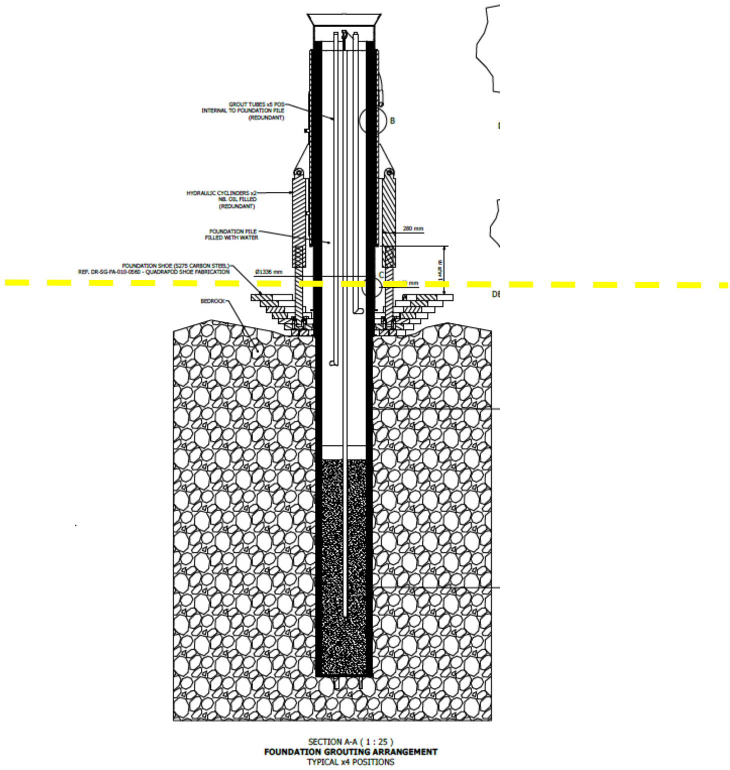


Figure 4.2: Image showing the base of the SeaGen device including the four feet (Image provided by SGL, 2016)

4.3.3. Cold Cutting

4.3.3.1. Diamond Wire Cutting

The diamond wire cutting tool (DWCT) features an endless loop of steel wire with carbon steel beads spaced at intervals along it covered with diamond particles. The wire is fed through drive guide wheels, which allow the wire to be driven at speed, creating the desired cutting action.

This tool could provide a clean cut through the pile without the need to recover and change out parts during the cutting process. The DWCT would be deployed from the decommissioning vessel and mounted onto the structure to be cut with assistance from a remotely operated vehicle (ROV).

This is a relatively time and cost-effective means of performing a remotely performed subsea cut. The equipment required is available, industry proven and has a very low environmental impact (Atlantis, 2016) (Figure 4.3).

Figure 4.3: Example of a Diamond Wire Cutting Tool (From: MOJO Maritime, 2012)

4.3.3.2. Abrasive Water Jet Cutting

Abrasive Water Jet Cutting (AWJC) works by propelling abrasive particles entrained in a water jet at extremely high velocities. The cut rate is dependent on a number of factors, including abrasive type, feed rate, water input, nozzle size, etc. The AWJC tool and nozzle would be deployed at the cut location with an ROV. The pressure pumps, abrasive mixers and control equipment would be positioned on the decommissioning vessel.

AWJC tools are generally used for pipelines with a diameter up to 900 mm, although larger diameter tools are available. This method is generally suitable for cutting of steel sections where speed is not critical, is ideal for pile cutting. The AWJC tool is remotely operated and once it is set up it requires minimal intervention. (Atlantis, 2016).

4.3.4. Hot Cutting

4.3.4.1. Thermic Lance

A thermic lance is a steel pipe packed with mixed metal wires. Pure oxygen gas is passed through the pipe from an oxygen cylinder and regulator. This type of cutting is commonly used in decommissioning activities using a device known as a 'Broco torch'. This method can cut aluminum, stainless steel, hardened steel, cast iron, etc. A diver is required to operate this equipment.

4.4. Vessel Types

Decommissioning will require the use of a sufficiently large platform to undertake cutting operations and remove the components of the structure. There are a number of possible vessel options and combinations under consideration for decommissioning the SeaGen device, namely:

- Jack-up vessel (JUV);
- Moored crane barge (MB);
- Workboat / Multicat vessel (WB) for initial preparatory work and to support larger HLVs; and
- Cargo barge (CB) to transport cut sections to the recycling site (with associated tug).

Table 4.3: Decommissioning vessel options

Vessel	Vessel Size	Footprint	Number of Tugs Required	Anchoring Handling Vessel
Jack-up vessel	150 m x 45 m	Four legs with approx. 40 m^2 footprint	Possible single tug for positioning 30 m x 22m or DP	None
Moored crane barge	100 m x 30 m	Four to eight 100 tonne gravity blocks (5 m x 5 m) or drag anchors (3 m x 5 m) with anchor chain 1m wide and precautionary estimate of 80 m on seabed	Possible two tugs (30 m x 22 m) or DP	Workboat / Multicat to install gravity blocks and for mooring
DP scenario	155 m x 30 m	Dynamic positioning	None	None

JUV and MB were considered within the pre-construction EIA in relation to both construction and decommissioning operations (Royal Haskoning, 2005).

The JUV may need to use DP in order to get into its final position prior to cutting. Therefore, DP is considered as a potential source of noise disturbance in the impact assessment.

4.5. Decommissioning Timescales

Decommissioning is a 2 Phase process:

Phase 1 of the decommissioning works, the removal of the powertrains and rotors, was completed in May 2016. The removal of the powertrains and rotors were categorised as operation and maintenance works and therefore were not required to be considered within an EIA.

Phase 2 of the decommissioning works will encompass the removal of the SeaGen superstructure, substructure and foundations, and this work is scheduled for Q1 2017. A worst case duration of three weeks of operations is used for assessment purposes. The second phase of the decommissioning works forms the basis of this ES.

5. Scoping Study

5.1. Decommissioning Scoping Report

The SeaGen Decommissioning Scoping Report (MarineSpace, 2016; Appendix C) considered all of the potential impacts on the receptors within Strangford Lough (including the Narrows) that might arise as a result of the decommissioning process. Potential interactions were scoped out if they had already been assessed as part of the SeaGen pre-construction EIA and it had been concluded that there was no impact or that the residual impact was negligible (Royal Haskoning, 2005).

As such, only the potential environmental impacts associated with SeaGen decommissioning that were not covered in pre-construction ES were assessed here. Table 5.1 shows a summary of the impacts that were originally scoped in the SeaGen Decommissioning Scoping Report (2016).

5.2. Consultation on Scoping Report

The SeaGen Decommissioning Scoping Report (MarineSpace, 2016; Appendix C) underwent a formal consultation with statutory and non-statutory stakeholders in June 2016, including the Northern Ireland Department of Agriculture, Environment and Rural Affairs (DAERA). In addition, the outcomes of the scoping report were presented to the SeaGen Liaison Group, comprising key stakeholders, on the 14 June 2016 at Queen's University, Belfast, Portaferry, where they had the opportunity to provide feedback.

A summary of the consultation responses and corresponding actions is included in Appendix D.

Table 5.1: Summary of the impacts that were scoped in for assessment (highlighted in yellow) (Source: MarineSpace, 2016)

Receptor	Potential Impact	Jack-up Barge	Moored Barge	DP Vessel	Diamond Wire	Abrasive Jet	Milling	Shaped Charges	Band Saw
Physical environment	Impact on wave climate in the Narrows								
	Impact on the flow regime of Strangford Lough								
	Deposition of heavier particulates								
	Release of contaminants during decommissioning								
Ecology	Benthic - loss or damage of benthic habitat of the Narrows during decommissioning								
	Benthic - damage to other benthic SAC features during installation								
	Fish resources – loss of feeding habitat								
	Fish resources – disturbance due to noise and vibration								
	Fish – impact on basking shark through noise disturbance								
	Pinnipeds – noise disturbance and injury								
	Pinnipeds – collision with decommissioning vessels								
	Pinnipeds – accidental release of contaminants								
	Cetaceans – noise disturbance and injury								
	Cetaceans – collision with decommissioning vessels								
	Cetaceans – accidental release of contaminants								
	Ornithology – noise disturbance								
	Ornithology – disturbance and loss of feeding resource								
	Introduction of invasive non-native species during installation								
	Navigation								
Human environment	Archaeology								

Receptor	Potential Impact	Jack-up Barge	Moored Barge	DP Vessel	Diamond Wire	Abrasive Jet	Milling	Shaped Charges	Band Saw
	Commercial fisheries - obstruction to movement								
	Diving and sailing								
	Visual								
	Landscape								
	Noise (above sea)								

6. Impact Assessment

The following sections of this decommissioning ES present the existing (baseline) environment and potential impacts on the various receptors identified via the scoping stage of this project.

As much as is possible, a standard approach was followed for each of the technical sections. The pre-construction baseline conditions were described together with any additional information collected during the EMP. Potential impacts of the decommissioning phase were then assessed, proposals for mitigation and best practice presented, and residual impacts assessed.

7. Hydrology, Geology and Water Quality

The following potential impacts were considered in the SeaGen Decommissioning Scoping Report and scoped out based on the determination in the pre-construction EIA that the residual impact from decommissioning was negligible and reversible over the short-term (Royal Haskoning, 2005; Appendix A):

- Impact on wave climate in the Narrows;
- Impact on the flow regime of Strangford Lough;
- Deposition of heavier particulates arising from cutting operations; and
- Release of contaminant during construction.

A detailed justification for the scoping out of these impacts is included in Appendix C, and a summary of the scoping consultation process is presented in Appendix D.

8. Benthic Ecology

8.1. Benthic Ecology Pre-construction Baseline

Strangford Lough supports a diverse floral and faunal assemblage and a wide range of marine habitats, due to the varying physical conditions found throughout the lough. These habitats have been mapped predominantly through monitoring surveys, including most recently an Agri-food and Biosciences Institute (AFBI) report on the bathymetry and habitat distribution across the lough (AFBI, 2015). The biotopes presented in this report can be seen in

Figure 8.2.

The seabed within the Narrows, where SeaGen is located, is characterised by large rocks and boulders covered with ascidians and hydroids. The strong currents that are prevalent in this area result in the presence of highly-adapted species including sponges and Dead Man's Fingers *Alcyonium digitatum* (Royal Haskoning, 2005).

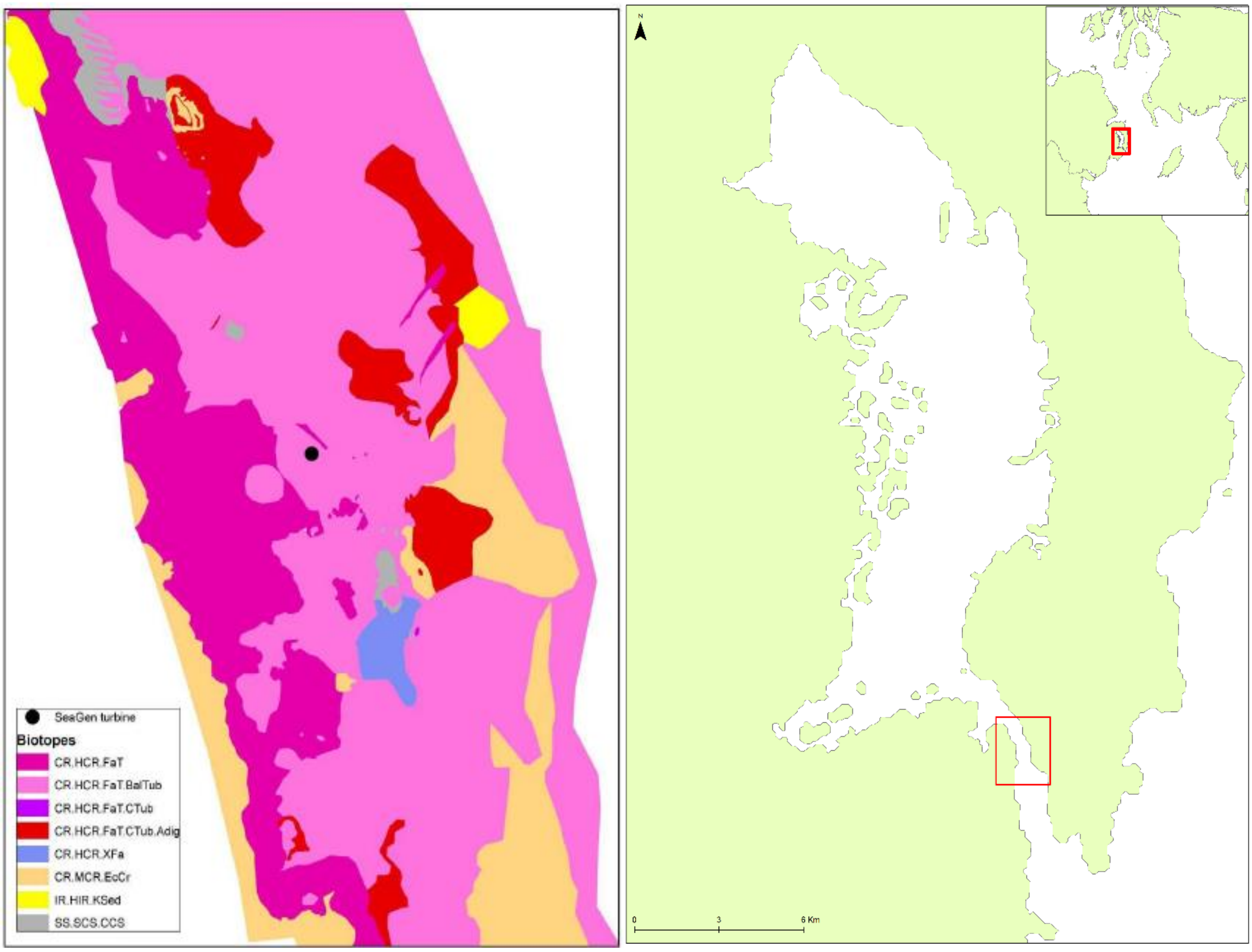
The results of the benthic survey conducted in the Narrows as part of the pre-construction SeaGen ES (Royal Haskoning, 2005) found large boulders, bedrock ridges, and exposed bedrock supporting a faunal turf with similar biota at each of the sites surveyed. The turf was dominated by hydroids *Sertularia argentea* and *Tubularia indivisa*, with sponges *Esperiopsis fucorum* and *Halichondria panacea* also present, and the occasional barnacle *Balanus crenatus*. The anthozoans present were limited to anemones *Urticina felina* and *Sagartia elegans*, with some patches of soft coral *Alcyonidium digitatum* also present. Mobile fauna included caprellids on the hydroids; the crabs *Pagurus bernhardus*, *Cancer pagurus*, *Hyas coarctatus* and *Liocarcinus puber*; the Dog Whelk *Nucella lapillus*; and the starfish *Asterias rubens*. The faunal turf supported large numbers of caprellid amphipods (Royal Haskoning, 2005). *Modiolus modiolus* beds were also present within the wider Strangford Lough area.

The two biotopes assigned to this current-swept faunal crust were:

- **CR.HCR.FaT.BalTub** *Balanus crenatus* and *Tubularia indivisa* on extremely tide-swept circalittoral rock; and
- **CR.HCR.FaT.CTub.Adig** *Alcyonium digitatum* with dense *Tubularia indivisa* and anemones on strongly tide-swept circalittoral rock.

These biotopes typically occur on upward-facing, extremely tide-swept, circalittoral bedrock, boulders and cobbles (Figure 8.1). As such, the pre-construction ES concluded that the benthic ecology within the area is represented by hardy species adapted to survive in harsh tide-swept conditions. In addition, work by MarLIN looking at the sensitivity of benthic species and habitats suggests that these biotopes are likely to recover quickly from any localised physical disturbance due to rapid recolonisation from adjacent areas of seabed.

Figure 8.1: Pre-installation biotope mapping by acoustic surveys with drop-down video ground-truthing (From: Royal Haskoning, 2011)



Benthic monitoring was undertaken during operation of SeaGen and was collected via diver video. Four sample stations were established to provide a time-series of monitoring information. Three stations were placed in-line with the rotational axis of the east turbine at approximately 20 m, 150 m and 300 m down/upstream to the southeast of the turbine installation. A further single reference station was installed approximately 50 m to the ENE of the turbine structure (Royal Haskoning, 2011).

Diver surveys were completed in March 2008 (baseline) and post-construction in July 2008, March 2009, July 2009 and April 2010.

Levels of colonisation upon the SeaGen device were also monitored throughout the operational phase during each diver survey. Organisms that characterise the mussel biotope, CR.MCR.CMus.CMyt were recorded as present and colonising the SeaGen structure. This biotope was not recorded in the Narrows during previous surveys. The CR.MCR.CMus.CMyt biotope, including mussel eggs is believed to provide a food source for some fish species, echinoderms and crustaceans and its addition to the Narrows is considered within the EMP survey report to be positive (Royal Haskoning, 2011).

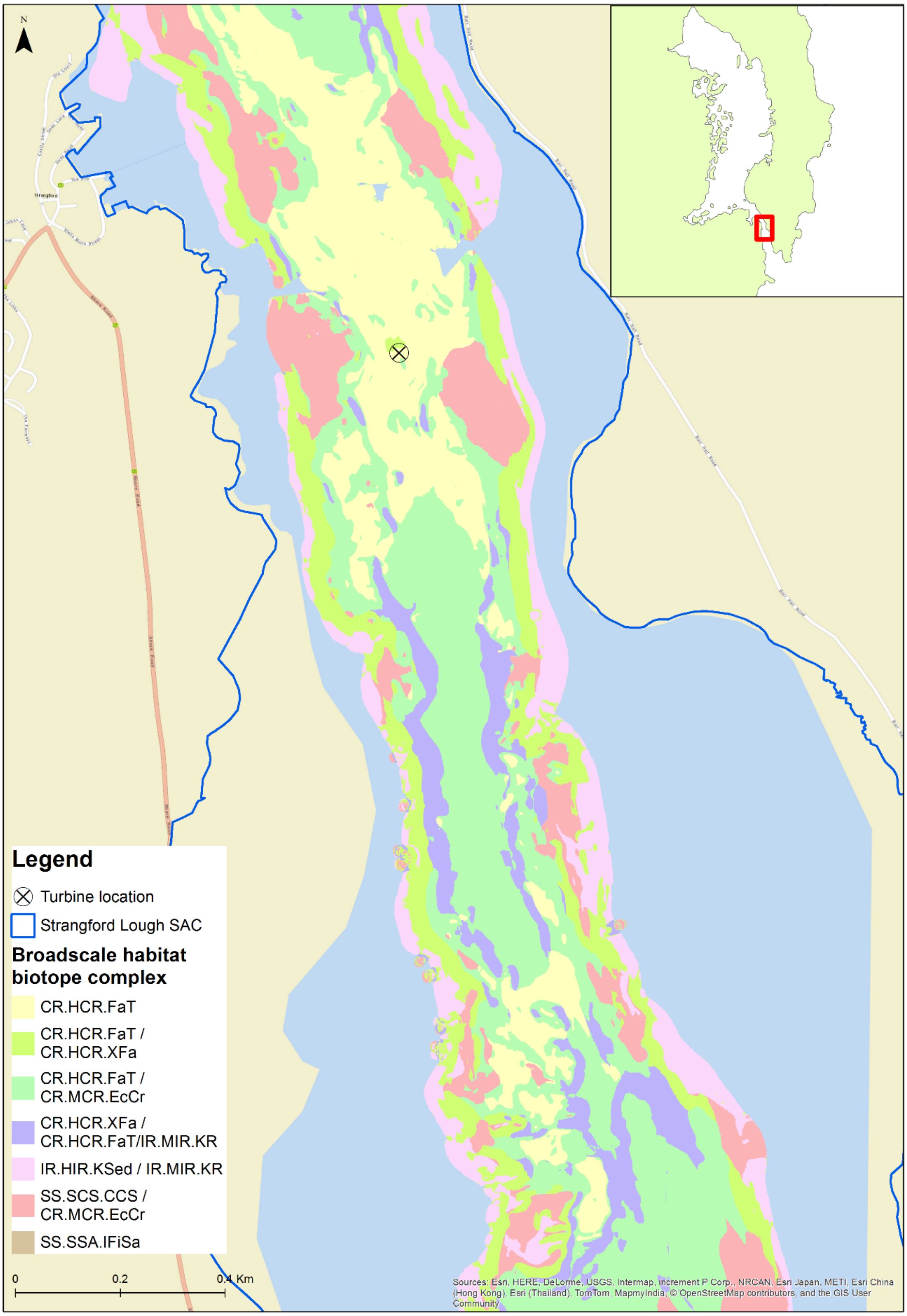
In addition, AFBI (2015) has conducted benthic monitoring within Strangford Lough SAC including the Narrows. The biotopes identified within this survey are presented in

Figure 8.2. The biotopes identified as present in the region of the SeaGen device during this survey were:

- CR.HCR.FaT – Very tide-swept faunal communities on circalittoral rock;
- CR.HCR.FaT/CR.HCR.XFa – Very tide-swept faunal communities on circalittoral rock / Mixed faunal turf communities on circalittoral rock; and
- CR.HCR.FaT/CR.MCR.EcCr – Very tide-swept faunal communities on circalittoral rock / Echinoderms and crustose communities on circalittoral rock.

These biotopes are directly comparable to those identified during the pre-construction surveys.

Figure 8.2: Biotope map for the Narrows area of Strangford Lough SAC (Source: AFBI, 2015)



8.2. Benthic Ecology Impact Assessment

8.2.1. Loss or Damage of Benthic Habitat

8.2.1.1. Jack-up Vessel

JUV may be used during decommissioning of the SeaGen device as a platform from which the cutting of the SeaGen structure could take place. The JUV could also be used to remove the components of the structure from the site.

JUV have four feet in contact with the seafloor during operation. This has the potential to impact upon the benthic communities beneath the footprint through physical abrasion of the substrate. It has been assumed the four feet each have a footprint of up to 10 m^2, with a total combined approximate footprint of 40 m^2 (Atlantis, 2016).

The total area of benthic habitat that will be impacted by each JUV deployment is 40 m^2. Even if the JUV takes several attempts to become stabilised, the overall footprint will be low; the assumed worst case scenario is that the JUV would take 10 attempts to find a suitable position, which would result in a total seabed footprint of 400 m^2 (4.0E-4 km^2). Therefore, the effects on benthic habitats will be extremely small and reversible even in the worst case scenario.

The decommissioning operations are expected to be conducted over three weeks. Therefore, the impacts from the jack-up feet will occur over a short period of time. Following this, the seabed will be undisturbed and the impacted benthic communities will be able to recover from the disturbance.

The environmental monitoring that was conducted within the SeaGen area as part of the post-construction monitoring measured the changes in the benthic habitats in the area. The results showed that the environment within the Narrows is subject to high levels of physical disturbance due to very fast tidal currents and, as such, a high level of natural variation can be expected of the benthic community. Furthermore, the final EMP report states that boulders move naturally due to strong tidal currents and result in patches of the benthos being abraded and disturbed, which maintains the benthic communities of the Narrows' boulder field in a constant natural state of succession (Royal Haskoning, 2011). Given this background of natural disturbance, any physical impacts associated with JUV on the faunal turf communities are predicted to be short-term and recovery will occur rapidly. Recovery following other activities that disturb the seabed has been observed for similar benthic communities, most notably for aggregate dredging (Waye-Barker, 2015; Newell and Woodcock, 2013).

Post-construction monitoring also demonstrated that subsurface SeaGen was rapidly colonised by the species characteristic of the substrate prior to installation (Royal Haskoning, 2011). This shows the ability of the benthic communities to recover rapidly from the impact of seabed disturbance and habitat loss, but also that the SeaGen feet to be left in-situ will not alter the types of species found in the locality.

As a result of the small extent of benthic habitat that could be impacted by JUV deployment, the short duration of the decommissioning process, the natural levels of disturbance within the area, and the rapid recovery observed during the benthic monitoring, it is concluded that **the impact on benthic communities due to the use of JUV will be negligible.**

8.2.1.2. Moored Crane Barges or Moored Barge

MBs may be used during decommissioning of the SeaGen as a platform from which the cutting of the SeaGen structure could take place. In addition, the MB could also be used to remove the components of the structure from the site. MBs use anchors in order to remain stationary. The use of anchors will impact a smaller area in comparison to JUV. However, due to the high tidal currents in the area there is the potential for anchor movement and therefore seabed abrasion as a result. The anchor will be deployed for a limited time is on the seabed and therefore overall the level of impact to benthic communities is considered comparable to that of the JUV.

The decommissioning operations are expected to be conducted over a three-week period. An MB will use between four and eight anchors, however the barge will need to be moved and anchors will be repositioned in order to cut all four legs, therefore 10 anchor footprints are considered. Anchor options include gravity anchors, each of approximately 5 x 5 m (25 m^2) or drag anchors of 3 x 5 m (15 m^2). The anchors may move during repositioning and therefore a new 5 m buffer has been assumed, additionally a corridor of 80 m that is 1 m wide is also assumed for a worst case scenario of slack chain movement on the seabed. It should be noted that the footprint of a proportion of the anchor chain catenary will also overlap from some of the worst case anchor footprint. The maximum estimated footprint of seabed impact for all anchors and chain catenary, for a large MB removing all four SeaGen legs is approximately 4,171 m^2.

The post-construction EMP measured changes in the benthic habitats in the area up to 300 m from the device. The results showed that the environment within the study area is subject to high levels of physical disturbance due to very fast tidal currents and, and as such a high level of natural variation can be expected of the benthic community. Furthermore, the final EMP report states that boulders may move naturally due to tidal currents and result in patches of the benthos being abraded and disturbed, which maintains the benthic communities of the Narrows' boulder field in a constant state of succession (Royal Haskoning, 2011). Given this background of natural disturbance, any physical impacts associated with the MB on the faunal turf communities are predicted to be short-term and recovery will occur rapidly (Waye-Barker, 2015; Newell and Woodcock, 2013).

The post-construction monitoring also demonstrated that subsurface SeaGen was rapidly colonised by the species characteristic of the substrate prior to installation. (Royal Haskoning, 2011). This shows the ability of the benthic communities to recover rapidly from the impact of seabed disturbance and habitat loss, but also that the SeaGen feet to be left in-situ will not alter the types of species found in the locality.

As a result of the small area of benthic habitat that will be impacted by the anchors of the moored barge, the short duration of the decommissioning process, the natural levels of disturbance within the area, and the rapid recovery observed during the benthic monitoring it is concluded that the **impact on benthic communities due to the use of MBs will be negligible**.

8.2.2. Summary

The assessments of the impacts of the SeaGen device have found that the decommissioning procedures will have a negligible impact upon benthic communities within Strangford Lough. Therefore, it is suggested that no mitigation is required to reduce the impacts upon benthic communities.

9. Fish and Shellfish

9.1. Fish and Shellfish Pre-construction Baseline

The variety of shellfish species present within the study area is typical of similar areas in this part of the UK. The shellfish species identified within the pre-construction ES are:

- Lobster *Homarus gammarus*;
- Prawns *Nephrops*;
- Crabs;
- Horse mussel *Modiolus 30odiolus*;
- Scallops *Pecten maximus* and *Aequipecten opercularis*;
- Dog cockle *Glycymeris glycymeris*; and
- Curled octopus *Eledone cirrhosa*.

The main fishery activity in the Narrows is creel fishing for lobster, crabs, and *Nephrops* spp. Sensitivity maps indicate that sprat *Sprattus sprattus* may spawn in the Lough during May to August (Coull *et al.*, 1998). Although Strangford Lough has the potential to act as a spawning area for this species, it is important to note that sprat spawn in nearshore waters all around the UK. Therefore, this area constitutes a very small proportion of the total spawning area of the species. The pre-construction ES also identified sea trout *Salmo trutta* as likely to pass through the Narrows. There has also been recent effort put into reinstating native oyster *Ostrea edulis* fisheries and there is an oyster farm producing pacific oysters *Crassostrea gigas* utilising a number of sites in the Lough.

Basking shark *Cetorhinus maximus* have also been recorded within Strangford Lough. This species is the largest fish found in UK waters, reaching a maximum length of 12 m (Shark Trust, 2016). Basking shark are common in inshore waters during the summer and are likely to be observed within Strangford Lough during the late summer months. Basking shark are generally seen at, or near, the surface of the water but they have also been recorded as deep as 1264 m. Basking shark are known to venture inshore to shallow bays, almost to the surf line, and are regularly sighted from land at certain times of the year (Shark Trust, 2016). There are also a number of Shellfish Water Protected Areas within Strangford Lough that are designated as part of the Water Framework Directive. These areas are discussed in more detail in the Nature Conservation section (Section 11).

9.2. Fish and Shellfish Impact Assessment

9.2.1. Noise and Vibration

9.2.1.1. Diamond Wire

A DWCT may be used during the decommissioning of the SeaGen device. DWC use a steel wire with small beads embedded with diamond particles mounted on the wire at regular intervals. The DWCT works like the cutting mechanism of a chain saw and the wire runs over pulleys mounted on a frame.

The preferred cutting location would be through the pin piles above the SeaGen feet (Figure 4.1; Figure 4.2) leaving the four feet in-situ. However, until the final decommissioning procedure has been confirmed by the preferred contractor, consideration will also be given to cutting through the main central pile. The worst case scenario for cutting time is up to 90 hours, though this would be non-continuous.

At the present time it is estimated to take up to 10 hours (plus rig-up and rig-down time), to cut through each quadropod leg. The 90 hours allows for contingency for:

(a) Equipment failure, in this event the DWCT would need to be redeployed at a new cutting location on the leg and the cut restarted; and
(b) Potential requirement to cut through the main central pile.

As fish species are mobile they are able to move away from areas where noise is being generated. The noise produced by DWCT may cause fish species to leave the area. However, due to the low noise levels produced and the short timeframe of this impact the magnitude and frequency of the impact will be low. It is expected that once the use of the DWCT has finished any fish that have been displaced will return to the area, so any impact caused due to noise and visual disturbance will be short-term and temporary.

Given the data presented in Panjerc *et al*. (2016) that the noise of the DWCT could not be distinguished from background noise within tens of metres, it is highly unlikely that the noise generated by DWCT has the potential to disturb any fish species.

There are very few examples of empirical data describing the source level of DWCT noise. One very recent study found that sound radiated from a DWCT operation (cutting steel pipe of similar diameter to the SeaGen pin piles , was not easily discernible above the background noise that was present during cutting operations (Panjerc et al. 2016). Mean-square sound pressure spectral levels did not exceed 130 dB at 100 m. DWCTs are widely used for decommissioning oil and gas structures (Genesis Oil and Gas 2011), but the sound generated during cold cutting techniques has previously assumed to be very limited with no potential or a significant effect on fish species. As a result of the above information it is concluded **that the impact of noise on fish due to the use of a DWCT is small-scale, temporary, and therefore negligible.**

9.2.1.2. Abrasive Water Jet

An AWJ may be used during the decommissioning of the SeaGen device. AWJCs produce a cutting jet of water mixed with an abrasive material under very high pressure (50,000 to 70,000 psi).

The preferred cutting location would be through the pin piles above the SeaGen feet (Figure 4.1; Figure 4.2) leaving the four feet in-situ. However, until the final decommissioning procedure has been confirmed by the preferred contractor, consideration will also be given to cutting through the main central pile. The worst case scenario for cutting time is up to 90 hours, though this would be non-continuous.

At the present time it is estimated to take up to 10 hours (plus rig-up and rig-down time), to cut through each quadropod leg. The 90 hours allows for contingency for:

(a) Equipment failure, in this event the DWCT would need to be redeployed at a new cutting location on the leg and the cut restarted; and
(b) Potential requirement to cut through the main central pile.

There is very little information on the noise levels produced during underwater AWJC, although in general the impact on marine life is considered to be low and AWJC has been termed an 'environmentally friendly' cutting method (Brandon et al. 2000, Kaiser et al. 2005). In the underwater noise technical report submitted in application for the East Anglia Three wind farm, it is suggested by the National Physics Laboratory (NPL) that for AWJ, a method anticipated for wind turbine removal, that the noise level would not be expected to be significantly higher than general surface vessel noise (East Anglia Three Ltd, 2015).

In-air studies have shown that AWJC produces peaks in noise at frequencies between 4-8 kHz (Hutt 2004). Although there have been no underwater measurements of the source level or propagation loss of water jet cutting, it is expected that the frequency spectra would be similar. Therefore, it is unlikely that the noise generated by AWJC will cause any disturbance of fish species. Given the short-term nature of the activities, **the impact of underwater disturbance to fish species as a result of AWJC is predicted to be negligible.**

9.2.2. Noise Disturbance (Basking Shark)

9.2.2.1. Jack-up Vessel

A JUV may be used during decommissioning of the SeaGen device as a platform from which the cutting of the SeaGen structure could take place. A JUV could also be used to remove the components of the structure from the site.

The presence of JUV has the potential to cause noise disturbance to fish species within Strangford Lough, including basking shark. However, basking shark are typically found in coastal waters from July to September, so at the time of decommissioning operations will not be in the lough.

The decommissioning process will require the JUV to be on site for the full duration of the works. The decommissioning operations are expected to be conducted on site over three weeks. As basking shark are a highly mobile species, they are able to move away from areas where noise is being generated, additionally the visual presence of the vessel may cause basking shark to leave the area. However, due to the short time frame of this impact the magnitude of the impact will be low. It is expected that once the JUP barge has left basking shark will return to the area, so any impact caused due to noise and visual disturbance will be short-term and temporary. Additionally, as the JUV will be stationary it is likely that any basking shark within the Narrows area will show a level of habituation due to the presence of the JUV.

The presence of JUV has the potential to cause noise disturbance to fish species within Strangford Lough, including basking shark. However, basking shark are typically found in coastal waters from July to September, so at the time of decommissioning operations will not be in the lough.

As a result of the above information it is concluded that the **impact of noise disturbance on basking shark is small-scale, temporary, and therefore negligible.**

9.2.2.2. Moored Barge

MBs in the form of heavy lift barges and flat top barges may be used during decommissioning of the SeaGen device as a platform from which to perform cutting methods. The presence of MBs has the potential to cause noise and visual disturbance to fish species within Strangford Lough, including basking shark.

The decommissioning process will require the MB to be on site for the full duration of the works. The decommissioning operations are expected to be conducted over three weeks.

As basking shark are mobile they are able to move away from areas where noise is being generated, additionally the visual presence of the vessel may cause basking shark to leave the area. However, due to the short time frame of this impact the magnitude of the impact will be low. It is expected that once the MB has left basking shark will return to the area, so any impact caused due to noise and visual disturbance will be short term and temporary.

MBs have the potential to cause noise disturbance to fish species within Strangford Lough, including basking shark. However, basking shark are typically found in coastal waters from July to September, so at the time of decommissioning operations will not be in the lough.

As a result of the above information it is concluded that the **impact of noise and visual disturbance on basking shark is small-scale, temporary, and therefore negligible.**

9.2.2.3. Diamond Wire

A DWCT may be used during the decommissioning of the SeaGen device to cut through the quadropod pin piles and substructure. DWCTs use a steel wire with small beads embedded with diamond particles mounted on the wire at regular intervals. The DWCT works like the cutting mechanism of a chainsaw and the wire runs over pulleys mounted on a frame.

The preferred cutting location would be through the pin piles above the SeaGen feet (Figure 4.1) leaving the four feet in-situ. However, until the final decommissioning procedure has been confirmed by the preferred contractor, consideration will also be given to cutting through the main central pile. The worst case scenario for cutting time is up to 90 hours, though this would be non-continuous.

At the present time it is estimated to take up to 10 hours (plus rig-up and rig-down time), to cut through each quadropod leg. The 90 hours allows for contingency for:

(a) Equipment failure, in this event the DWCT would need to be redeployed at a new cutting location on the leg and the cut restarted; and
(b) Potential requirement to cut through the main central pile.

Given the data presented in Panjerc *et al*. (2016) that the noise of the DWC could not be distinguished from background noise within tens of metres, it is highly unlikely that the noise generated by DWC has the potential to disturb basking shark.

As basking shark are a mobile species they are able to move away from areas where noise is being generated, and the noise produced during the use of the DWCT may cause basking shark to leave the area. However, due to the low noise levels produce and the short time frame of this impact the magnitude and frequency of the impact will be low. It is expected that once the use of the DWCT has finished any basking shark that has been displaced may return to the area, so any impact caused due to noise disturbance will be short term and temporary.

There are very few examples of empirical data describing the source level of DWC noise. One very recent study found that sound radiated from a DWC operation (cutting steel pipe of similar diameter to the SeaGen quadropod feet), was not easily discernible above the background noise that was present during cutting operations (Panjerc et al. 2016). Mean-square sound pressure spectral levels did not exceed 130 dB at 100 m. DWCTs are widely used for decommissioning oil and gas structures (Genesis Oil and Gas 2011), but the sound generated during cold cutting techniques has previously assumed to be very limited with no potential for a significant effect on basking shark. As a result of the above information it is concluded that **the impact of noise on basking shark due to the use of a DWCT is small-scale, temporary, and therefore negligible.**

9.2.2.4. Abrasive Jet

An AWJ may be used during the decommissioning of the SeaGen device to cut through quadropod pin piles and substructure. The AWJ produces a cutting jet of water mixed with an abrasive material under very high pressure (50,000 to 70,000 psi).

The preferred cutting location would be through the pin piles above the SeaGen feet (Figure 4.1) leaving the four feet in-situ. However, until the final decommissioning procedure has been confirmed by the preferred contractor, consideration will also be given to cutting through the main central pile. The worst case scenario for cutting time is up to 90 hours, though this would be non-continuous.

At the present time it is estimated to take up to 10 hours (plus rig-up and rig-down time), to cut through each quadropod leg. The 90 hours allows for contingency for:

(a) Equipment failure, in this event the DWCT would need to be redeployed at a new cutting location on the leg and the cut restarted; and
(b) Potential requirement to cut through the main central pile.

There is very little information on the noise levels produced during underwater AWJC, although in general the impact on marine life is considered to be low and AWJC has been termed an 'environmentally friendly' cutting method (Brandon et al. 2000, Kaiser et al. 2005). In the underwater noise technical report submitted in the application for the East Anglia Three wind farm, it is suggested by the National Physics Laboratory (NPL) that for abrasive cutting, a method anticipated for wind turbine removal that the noise level would not be expected to be significantly higher that general surface vessel noise (East Anglia Three Ltd, 2015).

In-air studies have shown that AWJC produces peaks in noise at frequencies between 4-8 kHz (Hutt 2004). The hearing characteristics of basking shark are currently unknown. The hearing bandwidth of the five species of elasmobranch which have so far been measured ranges from 20 Hz to 1 kHz, although caution must be applied before applying these data to all species (Casper *et al*., 2010). Although there have been no underwater measurements of the source level or propagation loss of AWJC, it is expected that the frequency spectra would be similar. Therefore, it is unlikely that the noise generated by AWJC will cause any disturbance of basking shark. Possible mitigation options in relation to use of AWJC will be discussed with the regulator if considered necessary.

Due to the short term nature of the activities and the assumption that noise levels will be analogous to general surface vessel noise, **the impact of underwater disturbance to basking shark as a result of AWJC is predicted to be negligible.**

As basking shark are a mobile species they are able to move away from areas where noise is being generated, and the noise produced during the use of the AWJC may cause basking shark to leave the area. However, due to the low noise levels anticipated to be produced and the short time frame of this impact the magnitude and frequency of the impact will be low. It is expected that once the use of the AWJC has finished any basking shark that has been displaced will be able to return to the area, so any impact caused due to noise and visual disturbance will be short term and temporary.

As a result of the above information it is concluded that the **impact of noise on basking shark due to the use of an AWJ is small-scale, temporary, and therefore negligible**.

9.2.3. Summary

The assessments of the impacts of the SeaGen device have found that the decommissioning procedures will have a negligible impact upon fish species, including basking shark, within Strangford Lough. Therefore, it is suggested that no mitigation is required to reduce the impacts upon fish species.

10. Marine Mammals

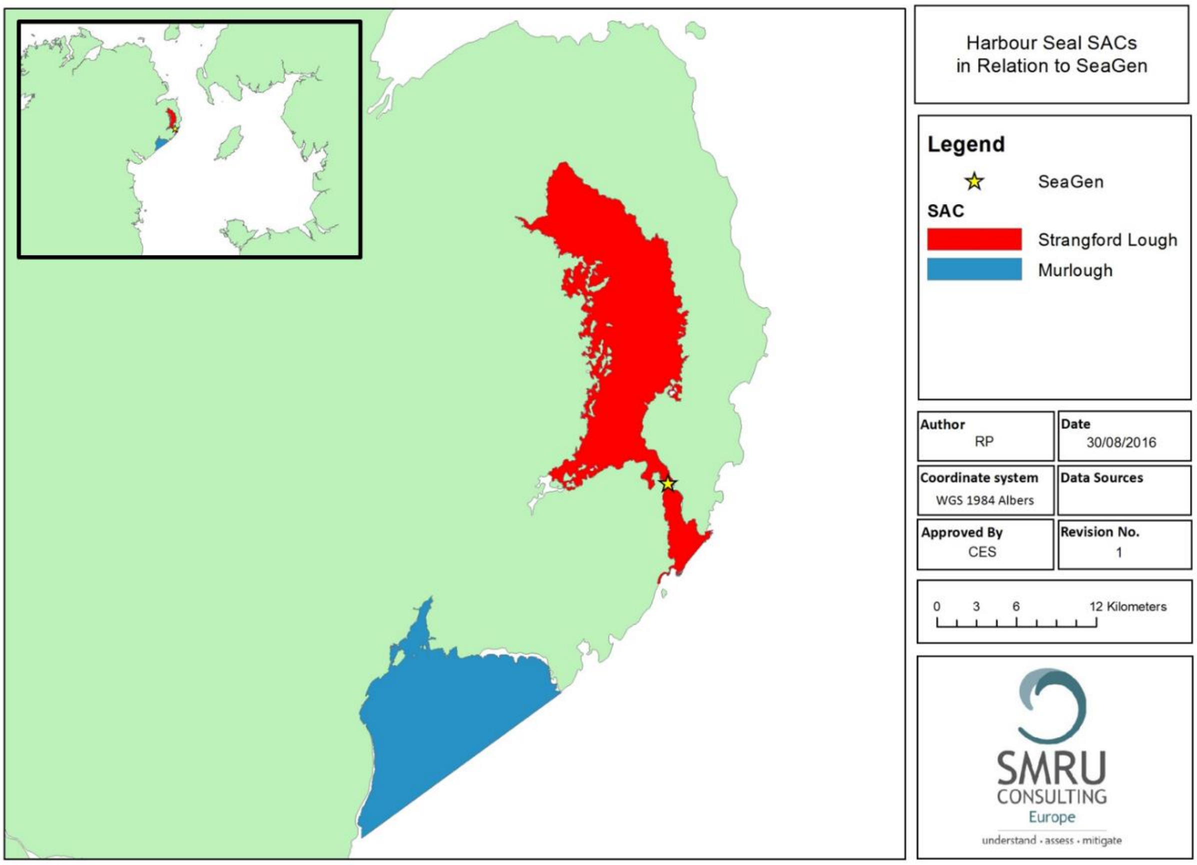
10.1. Marine Mammals Pre-Construction Baseline

10.1.1. Pinnipeds

Two species of seal are known to inhabit or visit Strangford Lough: harbour seal *Phoca vitulina* and grey seal *Halichoerus grypus* (Royal Haskoning, 2005). Harbour seal are present as a qualifying feature of the Strangford Lough SAC, although they are not a primary reason for designation (Figure 10.1). Seals are thought to use the Narrows as an access route to the main body of Strangford Lough and islands within the Narrows for hauling out and breeding. There are also two haul out sites in the Narrows, Cloghy Rocks and Granagh Bay, and these islands are important haul out sites for harbour seal but grey seal are also often counted there.

Another SAC in the vicinity of SeaGen is the Murlough SAC, which lists harbour seal as an Annex II species present as a qualifying feature but not a primary reason for site selection (Figure 10.1). The most recent reporting of the Conservation Status of harbour seal in the Strangford Lough SAC showed fluctuations in the maximum annual boat based counts of adult harbour seal between 2002 and 2007. The average count recorded in these surveys across all years was 211. Therefore, based on the objective of a harbour seal population of at least 200 adults within Strangford Lough SAC, the conservation status of the population was deemed to be favourable (Lonergan, 2013).

Figure 10.1: Harbour seal SACs in relation to SeaGen



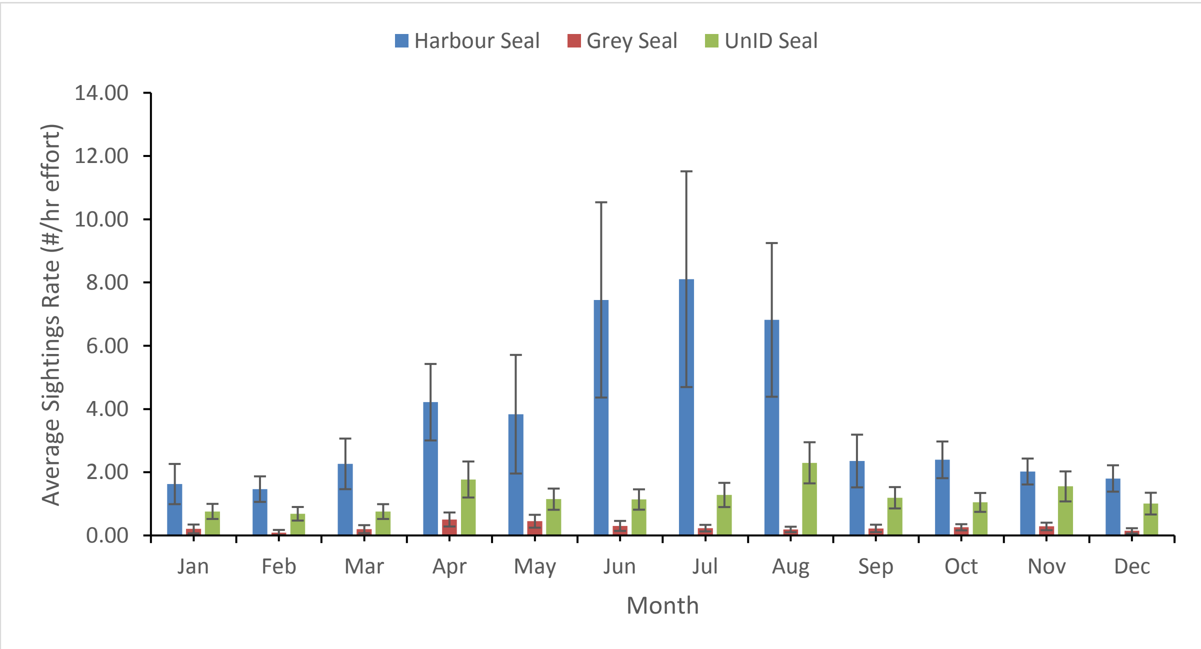
10.1.1.1. Pinniped Sightings

Land-based vantage point surveys were conducted at the Strangford Narrows between May 2005 and October 2010 as part of the SeaGen Environmental Monitoring Programme (EMP) on a total of 508 days, producing a total of 1,662 hours of effort. Harbour seal were by far the most commonly sighted species with a total of 6,290 harbour seal counted which produced an effort corrected sightings rate of 3.79 harbour seal /hour. Unidentified seal species were the next most commonly sighted, with 2,061 sightings producing an effort corrected sightings rate of 1.24 seals / hour. Grey seals were sighted far less regularly than harbour seal with a total of only 438 grey seal sighted resulting in an effort corrected sightings rate of 0.26 grey seal / hour (Table 10.1). The sightings rates of harbour seal varied seasonally with highest sightings rates between June, July and August where average monthly sightings rates between 2005 and 2010 reached up to 8.1 harbour seal /hour effort (Figure 10.2). Monthly average sightings rates were lowest in the winter months between November and March (1.47-2.26 harbour seal /hour effort).

Table 10.1: Seal species sighted during the land base vantage point surveys between May 2005 and Oct 2010.

	Harbour Seal	Grey Seal	Unidentified Seal
Total Effort (hr)	1,662	1,662	1,662
Total Count	6,290	438	2,061
Effort Corrected Sightings Rate (#/hr)	3.78	0.26	1.24

Figure 10.2: Seal monthly sightings rates during the land based vantage point surveys in the Narrows between May 2005 and Oct 2010. Error bars show 95% Confidence intervals.



10.1.1.2. Pinniped Counts

Long-term haul out count surveys have been conducted within Strangford Lough and Strangford Narrows in order to assess the population of seals. These counts were conducted between 1992 and 2015 by a combination of the National Trust and NIEA/DOENI Marine Division. The aim was for at least one survey per month, which was only achieved between 1993 and 1998. Beyond 1998 there were incomplete surveys where only some of the locations were counted and months without any counts, primarily due to issues with boat availability and bad weather. These count data represent raw counts and reflects the minimum number of seals present at the site. They do not represent the total population size as they have not been scaled to account for the proportion of the population at sea. The count surveys covered a total of 27 haul out sites in the Lough and Narrows where both harbour and grey seals were counted.

Harbour Seal

Numbers of harbour seal counted in the Strangford Lough and Narrows have decreased since count surveys began. Of those survey years where complete counts were made in July, August or September (during breeding and moult season and therefore the time of year when most harbour seal will be ashore and the most reliable count of a minimum population size), the count data show a decrease in these maximum counts from 325 in 1993 to 165 in 2013 (Figure 10.3). This time series of count data was modelled by Lonergan (2013) where it was shown that between 1993 and 2007 the harbour seal population decreased by around 3% per annum (Figure 10.4). The model combines a seasonal pattern with an interannual trend that changes in 2008 and a step change in that year. The reason for this decline is not well understood and may be a result of a combination of factors, including: changes in behaviour; changes in prey availability; disturbance or competition with grey seal.

Figure 10.3: Maximum harbour seal counts from complete counts made in either July, August or September (adults and pups) between 1993 and 2015.

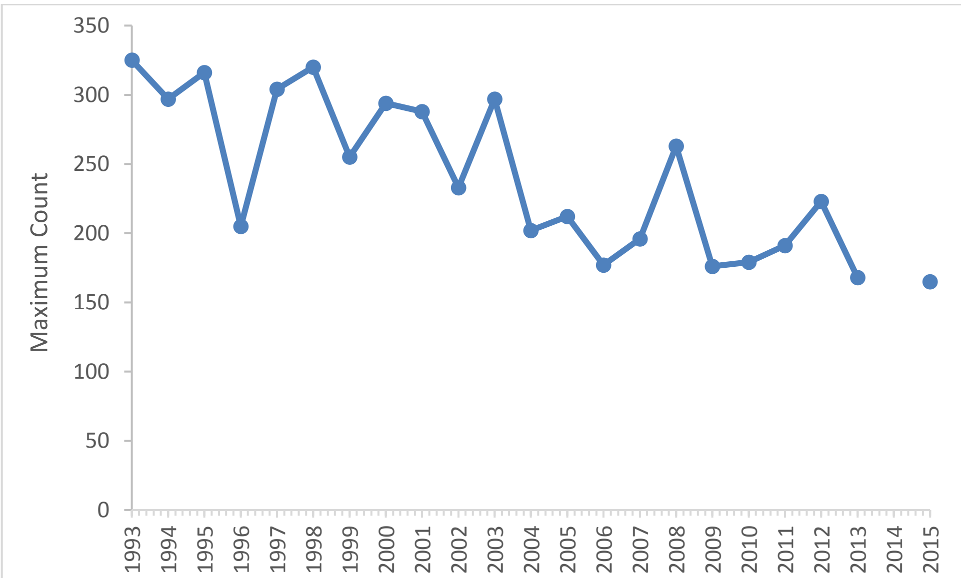
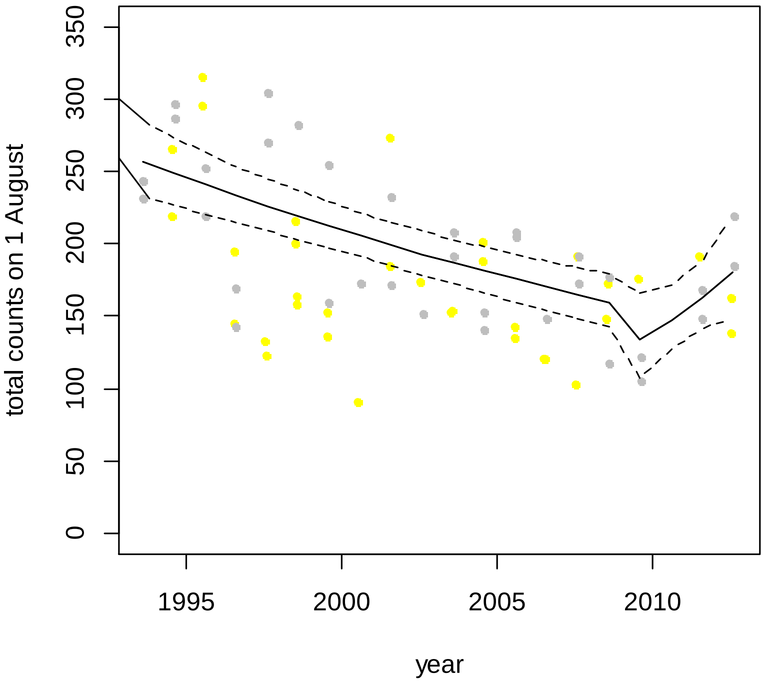
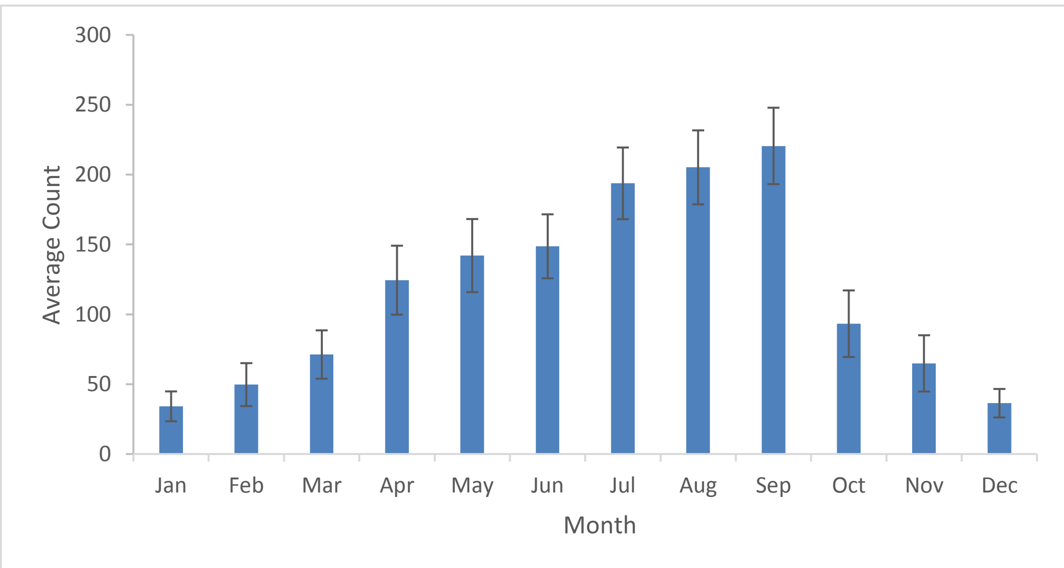


Figure 10.4: Modelled interannual changes in total numbers of harbour seal (adults plus pups) that would be counted in Strangford Lough and the Narrows on 1st August each year (Lonergan, 2013). The broken lines are 95% confidence intervals around the trajectory. Yellow points are counts made in July and grey ones those made during August.



The count data show a change in count numbers across the year with highest average counts recorded in the summer months between July and September (Figure 10.5). The maximum number of harbour seal counted in the Strangford Lough and Narrows was 325 harbour seal in July of 1993. This summer period coincides with the harbour seal breeding and annual moult period. Average counts between 1992 and 2015 were lowest for the winter months between November and March where average monthly counts ranged between 34 and 71 seals.

Figure 10.5: Average monthly harbour seal counts (adults and pups) between 1992 and 2015. Error bars show 95% confidence intervals.



Grey Seal

Numbers of grey seal counted in the Strangford Lough and Narrows have increased since count surveys began. Of those survey years where more than two months of data are available, the count data show an increase in average yearly counts from 18 grey seal in 1993 to a maximum of 104 grey seal in 2011 (Figure 10.6). The average count declined in 2012 and 2013 but this could be due to the lack of count surveys conducted during the grey seal breeding period during these two years. The grey seal population was observed to have increased by approximately 9% per annum until 2007 when a large increase of around 70% was observed between 2007 and 2009 (

Figure 10.7; Lonergan, 2013). The model combines a seasonal pattern with an interannual trend that changes in 2008 and a step change in that year. It is likely that this was due to large scale immigration from other areas rather than by natural increase of the population.

Figure 10.6: Average yearly grey seal counts (adults and pups) between 1993 and 2013.

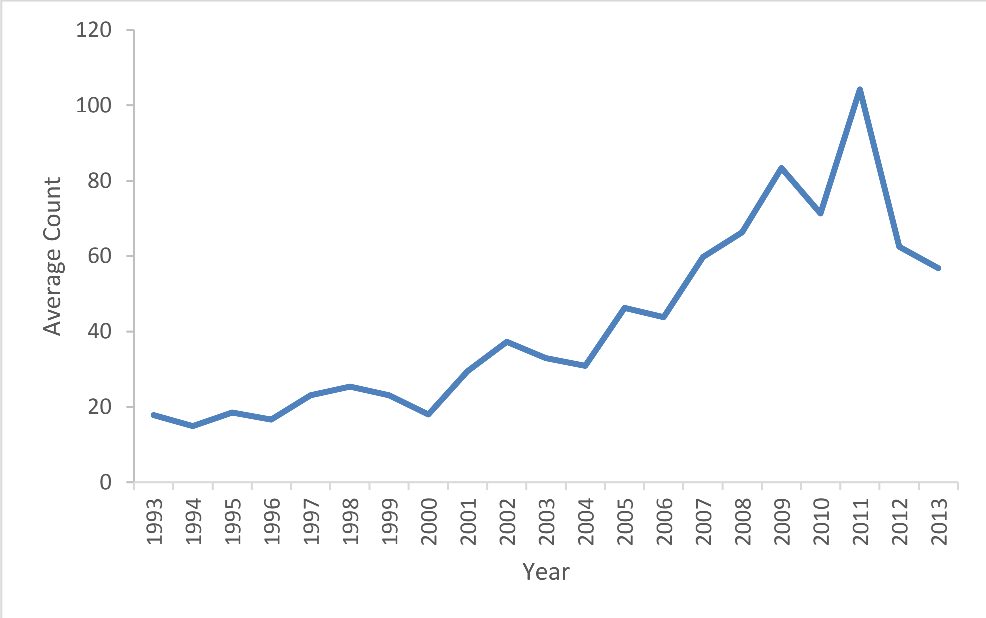
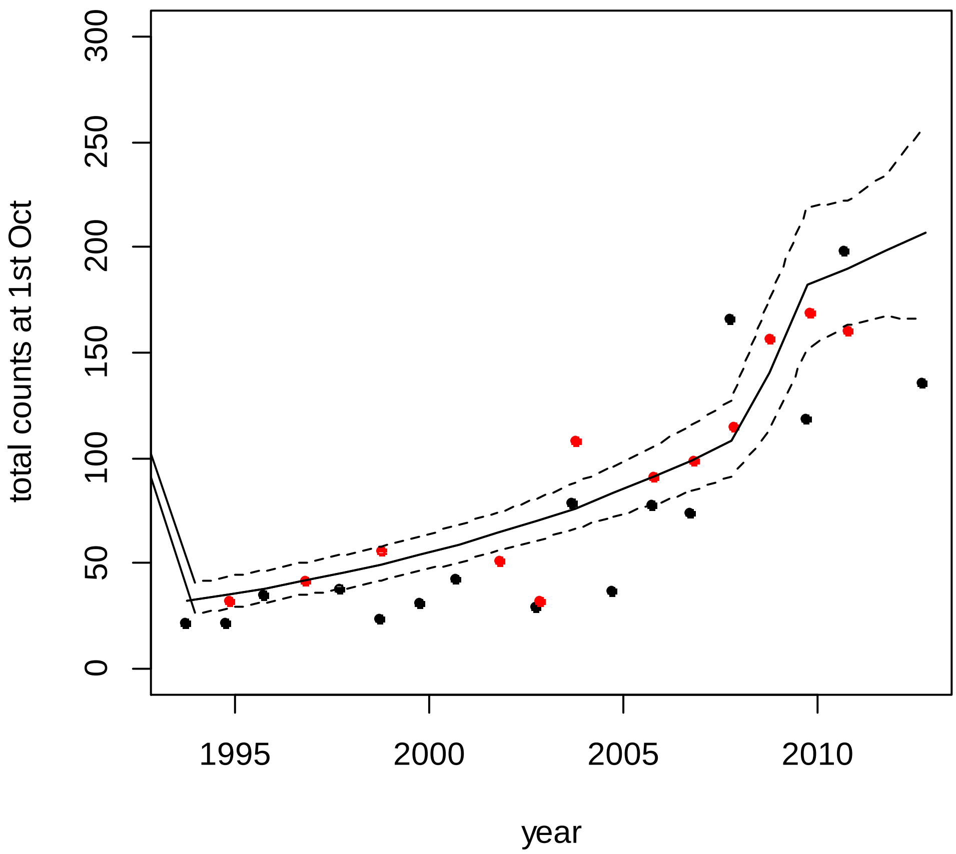


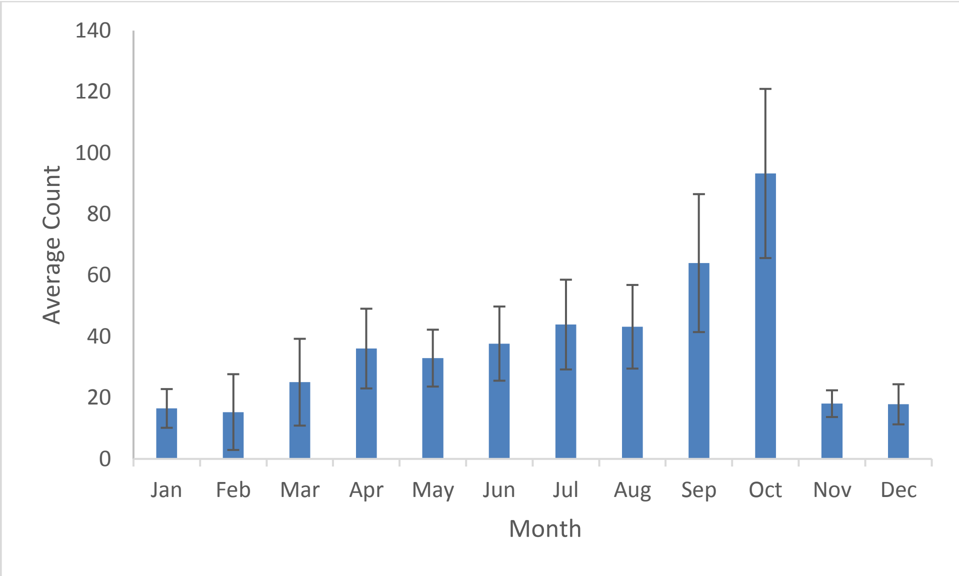
Figure 10.7: Modelled inter-annual changes in total numbers of grey seal (adults plus pups) that would be counted in Strangford Lough and the Narrows on 1st October each year (Lonergan, 2013). The broken lines are 95% confidence intervals around the trajectory. Black points are counts made in September and red ones those made during October.



The breeding season for grey seal is between September and November with the highest pup counts appearing in October. The count data show a change in numbers across the year with highest average counts recorded in October where average counts between 1992 and 2015 were 64 adults and 29 pups. Maximum counts were recorded in October 2011 with a total of 154 adults and 74 pups (

Figure 10.8). Average counts between 1992 and 2015 were lowest for the winter months between November and March where average monthly counts ranged between 17 and 25 seals.

Figure 10.8: Average monthly grey seal counts (adults and pups) between 1992 and 2015. Error bars show 95% confidence intervals.



10.1.1.3. Pinniped Telemetry

A total of 34 adult harbour seal have been tagged in the Strangford Lough since 2006 on three separate tagging events: 12 seals were tagged in April/May 2006, 10 were tagged in March/April 2008 and 12 were tagged in April 2010. While these tags provide data on the movement patterns of harbour seal tagged in Strangford Lough it should be noted that the telemetry data cover the period between the end of March and the end of July, which is outside of the scheduled decommissioning period for SeaGen and so may not be representative of harbour seal movement out with this monitored season.

The tags provided data for 2727 seal-days in total with an average of 80 days per tag. The telemetry data show movement between haul out sites in the Strangford Lough and Narrows and other haul out sites along the coast of Ireland and on the Isle of Man. Most tracks remained within 30 km from the entrance to the Strangford Narrows, with the furthest track extending east beyond the Isle of Man to near the entrance of the Solway Firth (~110 km from the entrance of the Strangford Narrows) (**Figure** 10.9). The telemetry data show connectivity between the Strangford SAC and the Murlough SAC where harbour seal are present as a qualifying feature. An example of two tagged harbour seal telemetry tracks are provided in

Figure 10.10 which shows that seals haul out both within Strangford lough and at haul out sites in the Narrows (concentrated clusters of tracks) and show transit from the Lough, through the Narrows and out to the Irish Sea. These data show that harbour seal regularly use Strangford Lough and the Narrows both for hauling out and for transiting between haul out sites.

Figure 10.9: Telemetry tracks from the 34 adult harbour seal tagged in Strangford Lough between 2006 and 2010.

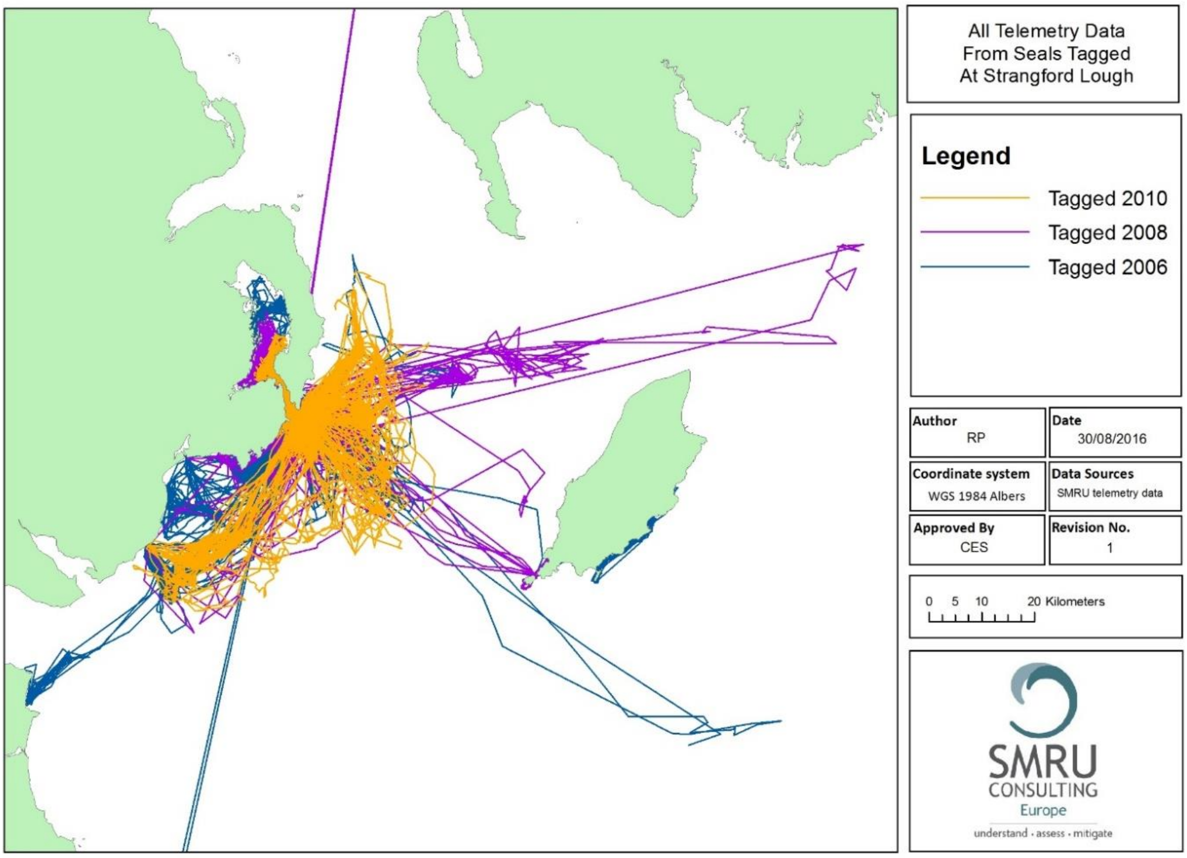
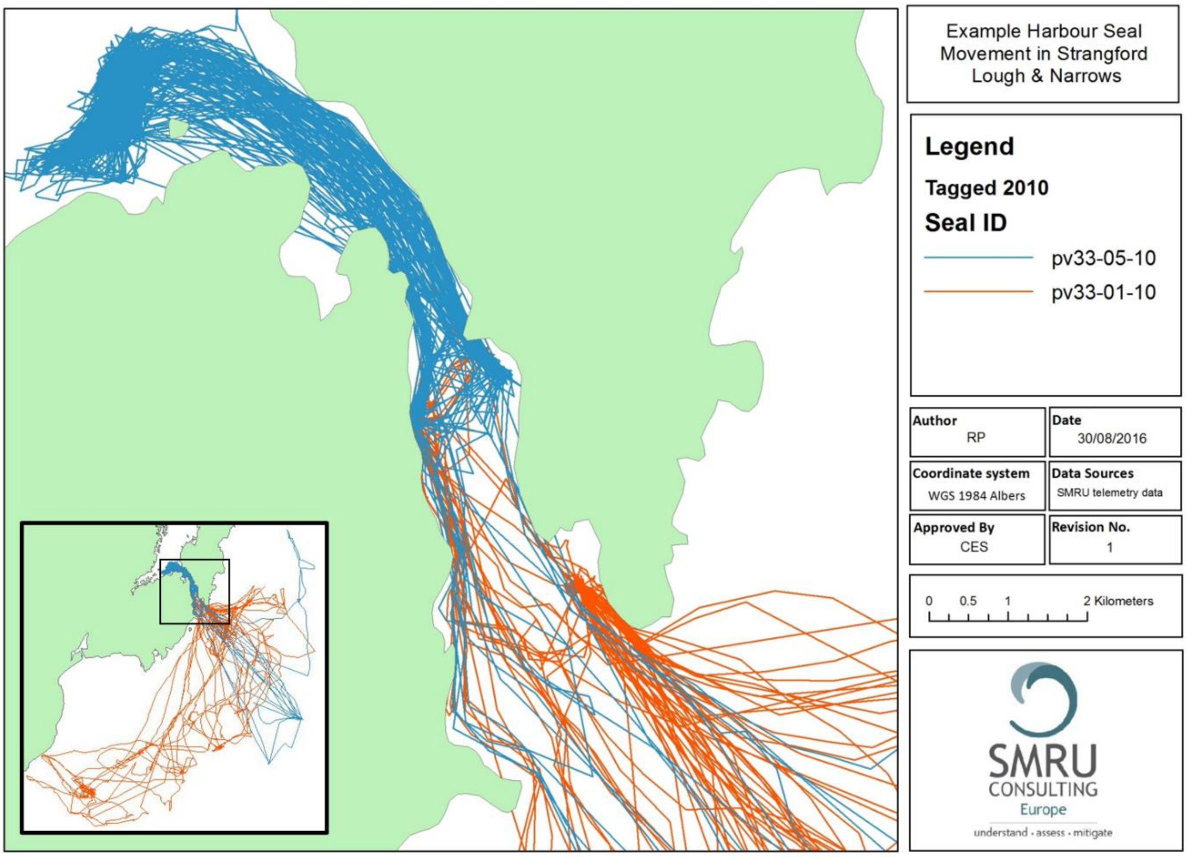


Figure 10.10: Example tracks from two adult harbour seal tagged in Strangford Lough in 2010 showing movement in the Lough and Narrows. Inset are full tracks for both individuals.



10.1.1.4. Conclusions

The long-term count data have shown a decline in harbour seal numbers and an increase in grey seal numbers in the Strangford Lough and Narrows between 1993 and 2013, although there is some evidence that the harbour seal population has been increasing again recently. Both the count data and vantage point survey sightings data confirm that seal abundance in Strangford Lough and in the Strangford Narrows is lowest in the winter months for both species. The decommissioning of SeaGen is scheduled between January and March 2017 and overlaps with the lowest counts and sightings of both species of seal.

10.1.2. Cetaceans

Harbour porpoise (*Phocoena phocoena*) are the most frequently sighted cetacean species in Strangford Lough and are known to forage for fish throughout the Lough. There are a few records of other cetacean species being sighted in the area; for example, a humpback whale was spotted in Strangford Lough in 2012, but long term visual and passive acoustic monitoring datasets have shown that other cetacean species are detected so rarely that they do not need to be considered further in this assessment.

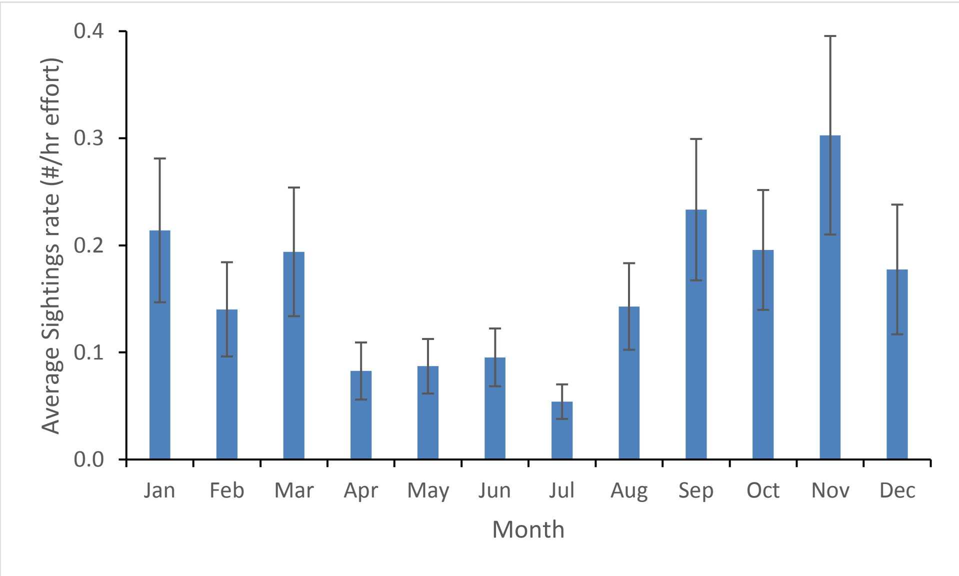
10.1.2.1. Cetacean Sightings

Land based vantage point surveys were conducted at the Strangford Narrows between May 2005 and October 2010 on 508 days, producing a total of 1,661.7 hours of effort. Porpoise were the least frequently sighted marine mammal species with only 277 sightings at an effort corrected sightings rate of 0.17 porpoise / hour (Table 10.2). No other cetacean species were sighted in the Strangford Narrows throughout the entire six-year survey duration. Monthly average sightings rates varied across the survey period with highest rates between September and November where average monthly sightings rates reached a maximum of 0.3 porpoise / hour effort in November (Figure 10.11). During the months of planned decommissioning activities (January-March) the average sightings rate was 0.18 porpoise / hour effort. This is equivalent to two porpoises being seen in the survey area every 12 hours.

Table 10.2: Porpoise sighted during the land base vantage point surveys between May 2005 and Oct 2010.

	Harbour Porpoise
Total Effort (hr)	1,662
Total Count	277
Effort Corrected Sightings Rate (#/hr)	0.17

Figure 10.11: Porpoise monthly sightings rates during the land base vantage point surveys between May 2005 and Oct 2010. Error bars are 95% confidence intervals.



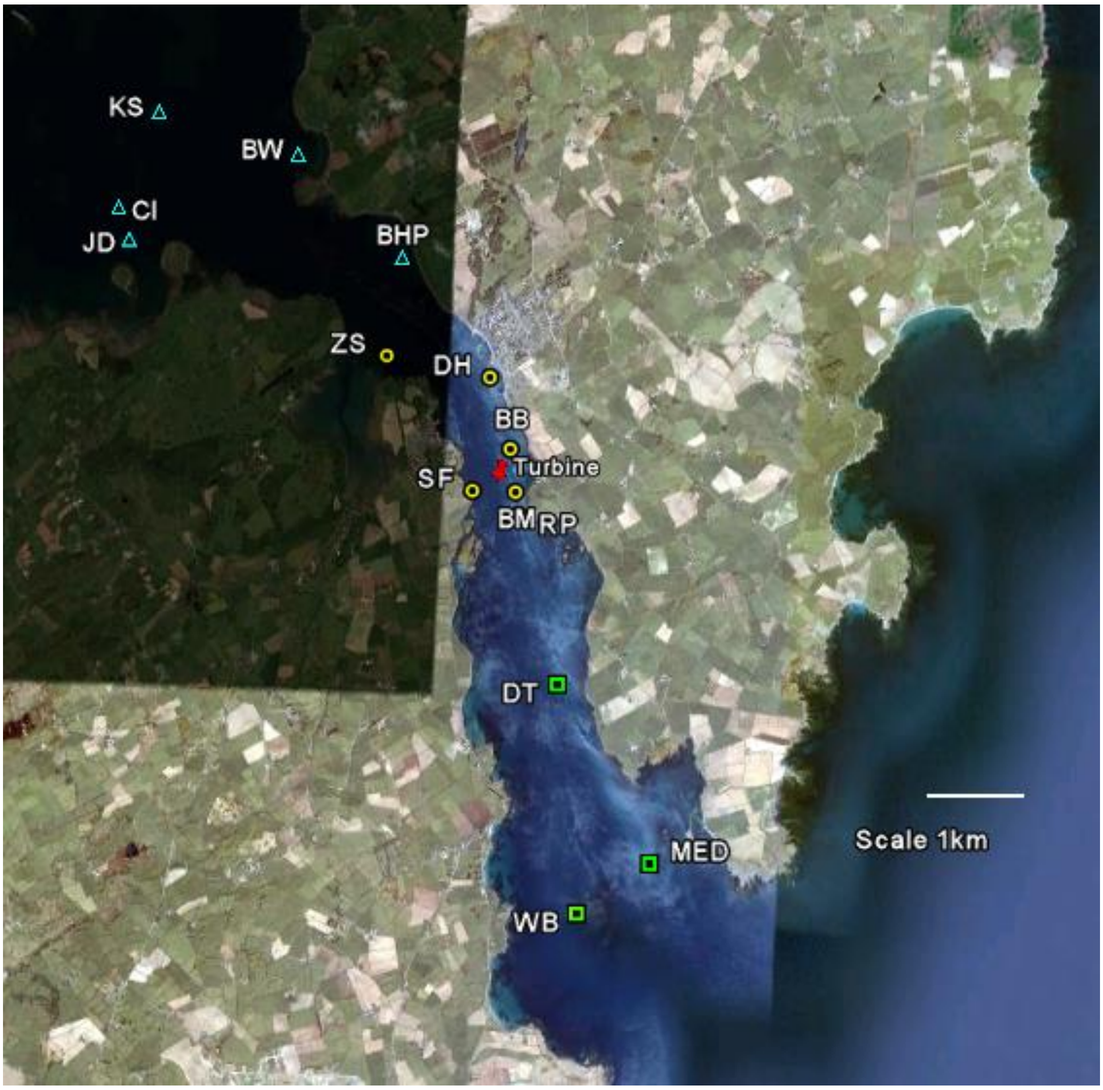
10.1.2.2. Cetacean Acoustic Monitoring

Passive acoustic monitoring (PAM) was conducted in the Strangford Lough and Narrows between March 2006 and March 2011 providing a total of 350,000 hours of data (Booth *et al.*, 2011). TPODs (acoustic monitoring devices) were deployed at 13 locations with in the inner Lough, the Narrows and the outer Lough to detect vocalising harbour porpoise.

The results of this study showed that porpoise were detected on 86% of the days during the study period indicating that porpoises are generally present in the region. It was noted, however, that this detection level was low compared to other sites that have previously been studied, which suggests that Strangford Lough and Narrows are not an important habitat for harbour porpoise compared to other sites in the Irish Sea (Booth *et al*., 2011). Overall detection rates were low, with most sites having porpoise detections in <10% of recording hours.

Porpoise were present in the inner Lough and the Narrows more (7% and 7.4% detection positive hours respectively) compared to the outer Narrows where the presence of porpoise was much lower (only 1.5% detection positive hours). The study also showed that detections were much higher during the night than the day, which previous studies have suggested may be linked to foraging (e.g. Carlstrom *et al*., 2005). The PAM data found that porpoise activity varied with month, with activity lowest in the summer months, peaks in activity levels in spring and autumn and a slight decline in activity in the winter. This PAM data shows a similar pattern in porpoise presence to the sightings data presented above. During the entire study period, there were no detections of any dolphin species at any of the TPOD stations.

Figure 10.12: Locations of all TPOD deployment sites. Triangular symbols represent Inner Lough sites, circular symbols are Narrows sites and square symbols are Outer Lough sites.



10.1.2.3. Conclusions

Two long-term intensive studies have shown that harbour porpoise are the only cetacean species detected with any regularity either visually or acoustically in the Strangford Lough and Narrows. Both the shore based visual sightings and the PAM data have shown that porpoise detections in the Strangford Lough and Narrows are low.

10.2. Marine Mammals Impact Assessment

10.2.1. Marine Mammal Impact Assessment 'Worst Case Scenario' Envelope

Although the complete details of the project design envelope are provided in Section 4, Table 10.3 provides an outline of the key parameters that are relevant for the marine mammal impact assessment. The main elements of the project parameters that are relevant to the marine mammal impact assessment are the methods used to cut the structure prior to removal (underwater noise impacts) and the vessels that will be used during the process (collision risk).

Table 10.3: 'Worst case scenario' parameters for Marine Mammal Impact Assessment

Element of Assessment	Description of Operation	'Worst Case Scenario' Assessment Parameters
Cold-cutting techniques	Combination of: Abrasive Water Jet Cutting (AWJC) and, Diamond wire cutting (DWC) to cut the feet of the structure. Both cutting tools will be deployed by diver, clamped to the structure and operated remotely.	Cutting tools will be deployed during slack tide using divers. Once deployed they will operate throughout the tidal cycle with an estimated 10 hours to cut each foot. Estimated one foot to be cut each day. AWJC will operate at pressures up to 60 kpsi. The preferred cutting location would be through the pin piles above the SeaGen feet, leaving the four feet in-situ, however until the final decommissioning procedure has been confirmed by the preferred contractor, consideration will also be given to cutting through the main central pile. The worst case scenario for cutting time is up to a maximum total of 90 hours, this would be non-continuous. At the present time it is estimated to take up to 10 hours (plus rig-up and rig-down time), to cut through each quadropod leg. The 90 hours allows for contingency for: (a) Equipment failure, in this event the DWCT would need to be redeployed at a new cutting location on the leg and the cut restarted; and (b) Potential requirement to cut through the main central pile.
Hot-cutting techniques	Brocotorch – subsea exothermic cutting. Diver operated to cut grout pipes, jacks and export cable/J tube.	As brocotorch is diver deployed, this method is limited to slack tide only, therefore restricting to a between 30 minutes or one hour in every six hours (depending on whether Spring or Neap). Total estimated cutting time is 14 hours.

Element of Assessment	Description of Operation	'Worst Case Scenario' Assessment Parameters
		Taking into account slack tide duration and daylight working requirements, diver operated cutting likely to operate over a 14-day period.
Heavy lift barge or jack up Vessel (JUV)	Jack up barge or heavy lift vessel moored alongside at SeaGen pile for whole duration of the operation.	A single move to site for the duration of the works by tug. If heavy lift barge is used it will be moved to a downstream position on each phase of the tidal cycle by tug, resulting in a total of 4 movements per 24-hour period over a total of a maximum of four weeks. These movements will be slow (<2 kts) and localised. DP thrusters may be required to get the vessel into final position. This would require DP thruster operation for a period of 10-30 minutes. JUV would not move once in position.
Support vessels	A tug, MultiCAT, DP or work vessel will be used for positioning barges and for daily transit of personnel to barge from Portaferry and Strangford.	A total of 2 daily transits for personnel transfer between Portaferry or Strangford and the pile over a total period of four weeks. These transits will operate maximum speeds of 14 kts (and reduce speed to 6 kts in the presence of marine mammals).

10.2.2. Underwater Noise Disturbance

Underwater cutting of the quadropod legs or through the main central pile is expected to be the highest source of sound associated with the decommissioning activities and the only potential noise source to create additional disturbance. There is very little information on the potential noise levels of underwater cutting methods, although in general the potential for impact is thought to be low.

In both potential techniques (AWJC and DWC) sound will be generated by the action of the cutter on the structure and by the machinery which drives the cutter. This sound may radiate into the water directly through the pile via a waterborne path or via the substrate by a ground borne path. The thresholds for auditory injury as defined as Permanent Threshold Shift by (Southall et al. 2007) will not be exceeded by any of the proposed cutting methods, therefore this assessment only considers the potential for disturbance.

10.2.2.1. Hot Cutting Techniques – Brocotorch

Since the Brocotorch is operated by a diver it is not anticipated that there is any potential for noise generated by this method to have any negative impact on marine life.

10.2.2.2. Diamond Wire Cutting Tools

There are very few examples of empirical data describing the source level of DWCT noise. One very recent study found that sound radiated from a DWCT operation (cutting steel pipe of similar diameter to the SeaGen quadropod feet), was not easily discernible above the background noise which was present during cutting operations (Panjerc et al. 2016). Mean-square sound pressure spectral levels did not exceed 130 dB at 100 m. DWCT are widely used for decommissioning oil and gas structures (Genesis Oil and Gas 2011), but the sound generated during cold cutting techniques has previously assumed to be very limited with no potential for a significant effect on any marine mammal species.

Given the data presented in Panjerc *et al*. (2016) that the noise of the DWCT could not be distinguished from background noise within tens of metres, it is highly unlikely that the noise generated by DWCT has the potential to disturb any species of marine mammal. It can be concluded therefore that due to the low potential for disturbance, the lower numbers of marine mammals around at the time of year, and the temporary nature of the activities that **the use of DWCTs will result in a negligible impact on both seals and harbour porpoise.**

10.2.2.3. Abrasive Water Jet Cutting

There is similarly very little information on the noise levels produced during underwater AWJC, although in general the impact on marine life is considered to be low and AWJC has been termed an 'environmentally friendly' cutting method (Brandon et al. 2000, Kaiser et al. 2005). In the underwater noise technical report submitted in application for the East Anglia Three wind farm, it is suggested by the National Physics Laboratory (NPL) that for abrasive cutting, a method anticipated for wind turbine removal that the noise level would not be expected to be significantly higher than general surface vessel noise (East Anglia Three Ltd, 2015).

In-air studies have shown that AWJC produces peaks in noise at frequencies between 4-8 kHz (Hutt 2004). These frequencies are far below the most sensitive hearing frequencies of seals (20 to 25 kHz; Ridgway and Joyce (1975)) and harbour porpoise (100-140 kHz; Kastelein *et al*. (2002)). Although there have been no underwater measurements of the source level or propagation loss of AWJC, it is expected that the frequency spectra would be similar. Therefore, it is unlikely that the noise generated by AWJC will cause any disturbance of harbour porpoise or seals. Possible mitigation options in relation to use of AWJC will be discussed with the regulator if considered necessary.

Due to the short term nature of the activities and the assumption that noise levels will be analogous to general surface vessel noise, **the impact of underwater disturbance to marine mammals as a result of AWJC is predicted to be negligible.**

10.2.2.4. Vessel Noise

There will be an increase in the number of vessels in the Narrows as a result of the decommissioning activities. Increased vessel traffic will result in an increase in underwater noise caused by vessel propellers, which has the potential to disturb marine mammals. Based on noise levels presented in Richardson (1995) any auditory injury from ships is unlikely.

There will only be an estimated four vessels associated with decommissioning activities in operation at any one time (a JUV or MB and a maximum of two tugs or a DP vessel for positioning and a workboat or Multicat to install gravity blocks and for mooring; Table 10.3). The principal vessel movements will be between the shore and SeaGen for personnel transit and the worst case assessment is based on daily transits to and from the SeaGen site from either Portaferry or Strangford over a maximum period of three weeks operation on-site. MBs or JUVs will be stationary and will not produce any engine noise. Studies have shown that tug boats produce sounds between 145-166 dB re 1 μPa rms at 1m and generally emit sounds at a frequency of <5 kHz which means the noise produced by the tug propellers is lower than the dominant hearing frequencies for either seals or porpoise (Richardson 1995).

Assessments on behavioural disturbance ranges from small work vessels vessels are very limited; tugs have been previously assessed as having a potential disturbance range of up to 750 m (Xodus Group Ltd 2015) but this was based on a conservative 120 dB re 1µPa rms criterion which is considered to be too conservative for use at a tidal site where ambient sound levels can exceed 120 dB. Another assessment of vessel activity during offshore wind farm construction concluded medium sized vessels operating continuously for 24 hours would not be predicted to cause any behavioural responses in either grey or harbour seal and were predicted to cause behavioural responses in harbour porpoise only out to a distance of 11 m (King 2013). Since this assessment was focused on medium sized vessels (which are likely to be larger than small work vessels such as tugs) and the disturbance was modelled for continuous vessel noise, the likely disturbance range for smaller work vessels such as tugs would be lower. It may be required to use the thrusters of a dynamic positioning vessel for the final positioning for cutting if a JUV is used – any DP thruster use will be of short duration, likely to be approximately ten to thirty minutes. The noise levels from DP thrusters are likely to be greater than those from normal propellers and the potential for temporary disturbance is greater. Nedwell and Edwards (2004) demonstrated that the use of thrusters by a drill ship caused an elevation of the low frequency sound from about 2 or 3 Hz up to about 30 Hz. Nedwell and Edwards (2004) concluded that there was a strong possibility that these levels may be sufficient to cause marine mammal species to avoid the close proximity of the ship. However given the very short duration of this activity (a single period of positioning up to thirty minutes in duration) this is very unlikely to have a significant impact on any marine mammals.

Vessel traffic already operates in this area daily; near continuous ferry crossings between Strangford and Portaferry, a small number of creel fishing boats, charter RIBs, other work boats, the RNLI lifeboat and occasional leisure craft. In particular, the ferry service runs for approximately 16 hours each day, 364 days per year, making a journey between the harbours every fifteen minutes (Appendix E). Therefore, decommissioning vessel activity will not represent a significant increase in the amount of vessel noise experienced by marine mammals in the Narrows. In addition, regular vessel traffic between Portaferry and SeaGen was a feature for the operation and maintenance period of the SeaGen turbine with no significant effects recorded on the marine mammal populations of the Narrows and Lough.

Given the low number of vessel movements compared to baseline levels in the Narrows, the infrequent nature and short duration of activity, **the impact of any additional disturbance to seals or cetaceans in the Narrows as a result of the vessel noise during decommissioning activities is considered to be negligible.**

10.2.3. Collision with Vessels

There will be an increase in the number of vessels in the Narrows as a result of the decommissioning activities. Increased vessel traffic can result in an increase for the potential for physical trauma and death of marine mammals as a consequence of collisions with moving vessels. The increase in the number of vessels will be marginal given that an estimated four additional vessels will be present at any one time (a JUV or MB and a maximum of two tugs for positioning or support vessels; Table 10.3). Other than the single movements to and from the site at the start and end of the decommissioning activities, the principal vessel movements will be between the shore and SeaGen for personnel transit.

It is possible that contractors will have accommodation on the heavy lift vessel or MB, and therefore these movements will be limited in nature; however, the worst case assessment is based on daily transits to and from the SeaGen site from either Portaferry or Strangford. As noted in Section 9.2.2. vessel traffic already operates in this area daily. The ferry service runs for approximately 16 hours each day, 364 days per year, making a journey between the harbours every fifteen minutes (Appendix E). Therefore, the decommissioning vessel transits do not represent a significant increase in the number of vessel movements in the Narrows. In addition, regular vessel traffic between Portaferry and SeaGen was a feature for the operation and maintenance period of the SeaGen turbine with no significant effects recorded on the marine mammal populations of the Narrows and Lough.

The routes taken will be regular and predictable and transits will occur at maximum speeds of 14 kts with a reduction to 6 kts if any marine mammals are sighted during transits. Because of the small number of additional vessels and the low number of vessel movements over a short timeframe of four weeks, **the impact of any collision risk to seals or cetaceans in the Narrows as a result of the decommissioning activities is considered to be negligible.**

10.2.4. Summary

Table 10.4 provides a summary of the marine mammal impacts associated with decommissioning activities. It is predicted that none of the underwater cutting techniques is likely to produce noise at a level that will result in any significant disturbance to marine mammals in the vicinity of the decommissioning activities. Existing data suggests that source levels of DWC are hard to distinguish from background noise, particularly in the presence of vessels. There is only a very small increase in vessel numbers expected to occur in the Narrows as a result of the decommissioning activities. This short-term increase is not predicted to have a significant impact on any marine mammals.

Table 10.4: Summary of Marine Mammal Impact Assessment

Element of assessment	Predicted significance of impact	Embedded mitigation	Residual significance of impact
Underwater noise: cold-cutting techniques: AWJC and DWC	Negligible for all marine mammal species.	Activities taking place during Jan to March when abundance of marine mammals is low. Additional possible mitigation options in relation to use of AWJC will be discussed with the regulator if considered necessary.	Negligible
Underwater noise: Hot-cutting techniques	Negligible for all marine mammal species.	Activities taking place during Jan to March when abundance of marine mammals is low.	Negligible
Underwater noise: Vessels	Negligible for all marine mammal species.	Activities taking place during Jan to March when abundance of marine mammals is low.	Negligible
Collision with vessels	Negligible for all marine mammal species.	Activities taking place during Jan to March when abundance of marine mammals is low lower than other times of year. Maximum vessel speeds implemented.	Negligible

11. Translocation of Invasive Non-native Species

11.1. INNS Pre-construction Baseline

The introduction of man-made intertidal and sub-tidal structures into the marine environment can create novel habitat for biota that favour a hard substrate where otherwise there was none, providing a substrate for spread of invasive non-native species. Research has shown that as the presence and extent of intertidal structures increase, opportunities for both indigenous and exotic species also increase, potentially leading to invasion of a natural habitat by an invasive species (Adams *et al*., 2014; Bulleri and Chapman, 2010). Relevant structures include coastal flood defences, harbour or general infrastructure, and theoretically SeaGen.

Not all species that arrive from areas outside the UK are considered invasive. An invasive organism is one introduced by man into places out of their natural range, and becomes established, generating a negative economic or environmental impact on the local ecosystem (IUCN, 2011).

Both *Sargassum muticum* and *Spartina anglica* have both been recorded in Strangford Lough previously. *S. muticum* was first identified in Strangford Lough in 1995 and *S. anglica* was deliberately introduced into the lough in the 1940s. Neither were found in the survey area throughout the EMP.

11.2. INNS Impact Assessment

Many species have been recorded as colonising SeaGen during the post-installation monitoring surveys, including the common mussel *Mytilus edulis*, and acorn barnacle *Balanus crenatus*.

A major concern is the spread of invasive non-native species is the carpet sea squirt *Didemnum vexillum*, (should it be present on SeaGen superstructure) by decommissioning activities. *D. vexillum* has been known to have negative impacts on indigenous benthic communities in areas where it has been recorded in the past. In particular, *Didemnum vexillum* has implications for aquaculture industries through smothering of structures and shellfish. These effects can be controlled through management works and control of transport vectors (Payne *et al*., 2014). In addition, *D. vexillum* can also have negative effects on indigenous benthic habitats and species through smothering and alteration of CO_2 budget (Dupont *et al*., 2008; Gittenberger, 2007).

D. vexillum was first recorded in Strangford Lough in 2012 at the Ballydorn Lightship, to the northwest of the lough. This location is over 10 km to the north of the SeaGen device. Subsequent monitoring has shown that in four years the sea squirt has spread to a pontoon 400 metres from the original source and there is no evidence that it is elsewhere in the lough (Joe Breen, DAERA, pers comm). Therefore, the likelihood of this species being found on the SeaGen structure is very low.

D. vexillum has never been identified upon SeaGen’s subsurface during the monitoring surveys that have been conducted (Royal Haskoning, 2011). Furthermore, the subsurface structure was inspected by ROV in May 2016 during preparation for decommissioning and the ROV footage circulated to the DWG for review. There was no evidence of mature *D. vexillum* colonies anywhere on the structure.

No ballast water will be exchanged or discharged within 3nm of the entrance to the Narrows. Coupled with normal hull antifouling procedures, the likelihood of INNS translocation is reduced to a very low risk. In addition to this upon awarding the works contract the history of the transit of any decommissioning vessels used will be provided so that if the vessel has been in any high risk areas for invasive species this will be highlighted.

Given the absence of *D. vexillum* colonies on the SeaGen structure, the fact that no INNS have been observed throughout the EMP, and normal hull antifouling procedures the **risk of translocation of INNS is considered to be negligible**.

12. Nature Conservation

Strangford Lough supports a wide range of marine habitats and species, with over 2,000 recorded species. It is important for marine invertebrates, algae and saltmarsh plants, for wintering and breeding wetland birds, and for marine mammals. Within Strangford Lough area there are a number of designated nature conservation areas. These sites are summarised in Table 12.1. In addition to the sites listed in the following table, there are also seven National Nature Reserves (NNRs) within the Strangford Lough area.

Table 12.1: Nature conservation designated sites within the Strangford Lough area

Site	Reason for Designation
Strangford Lough SAC	Designated for the presence of the following Annex I habitats: • Large shallow inlet and bay; • Coastal Lagoons; • Mudflats and sandflats not covered by seawater at low tide; • Reefs; • Annual vegetation of drift lines; • *Salicornia* and other annuals colonizing mud and sand; • Atlantic salt meadows (*Glauco-Puccinelietalia maritimae*); and • Perennial vegetation of stony banks. Designated for the presence of the following Annex II species: • Harbour seal *Phoca vitulina.*
Strangford Lough MCZ	Strangford Lough's 1995 designation as a Marine Nature Reserve (MNR) has now been superseded by the Marine Act (Northern Ireland) 2013: Strangford Lough MNR became Strangford Lough Marine Conservation Zone (MCZ) when this legislation came into operation on 17 September 2013. The reserve (now MCZ) includes all the waters, sea bed and shores (up to high water mark mean tide) of Strangford Lough itself plus those of an area around the mouth of the Lough.
Shellfish Water Protection Areas	There are three Shellfish Water Protection Areas within Strangford Lough: • Reagh Bay; • Marlfield Bay; and • Skate Rock. Within the River Basin Management Plan Structure, existing shellfish waters have now become Water Framework Directive Protected Areas, for the protection of economically significant aquatic species.
Strangford Lough SPA	Designated for the presence of the following species: • Arctic Tern *Sterna paradisaea;* • Common Tern *Sterna hirundo;* • Sandwich Tern *Sterna sandvicensis;* • Bar-tailed Godwit *Limosa lapponica;* • Golden Plover *Pluvialis apricariar*; • Knot *Calidris canutus;* • Light-bellied Brent Goose *Branta bernicla hrota;* • Redshank *Tringa tetanus;* and

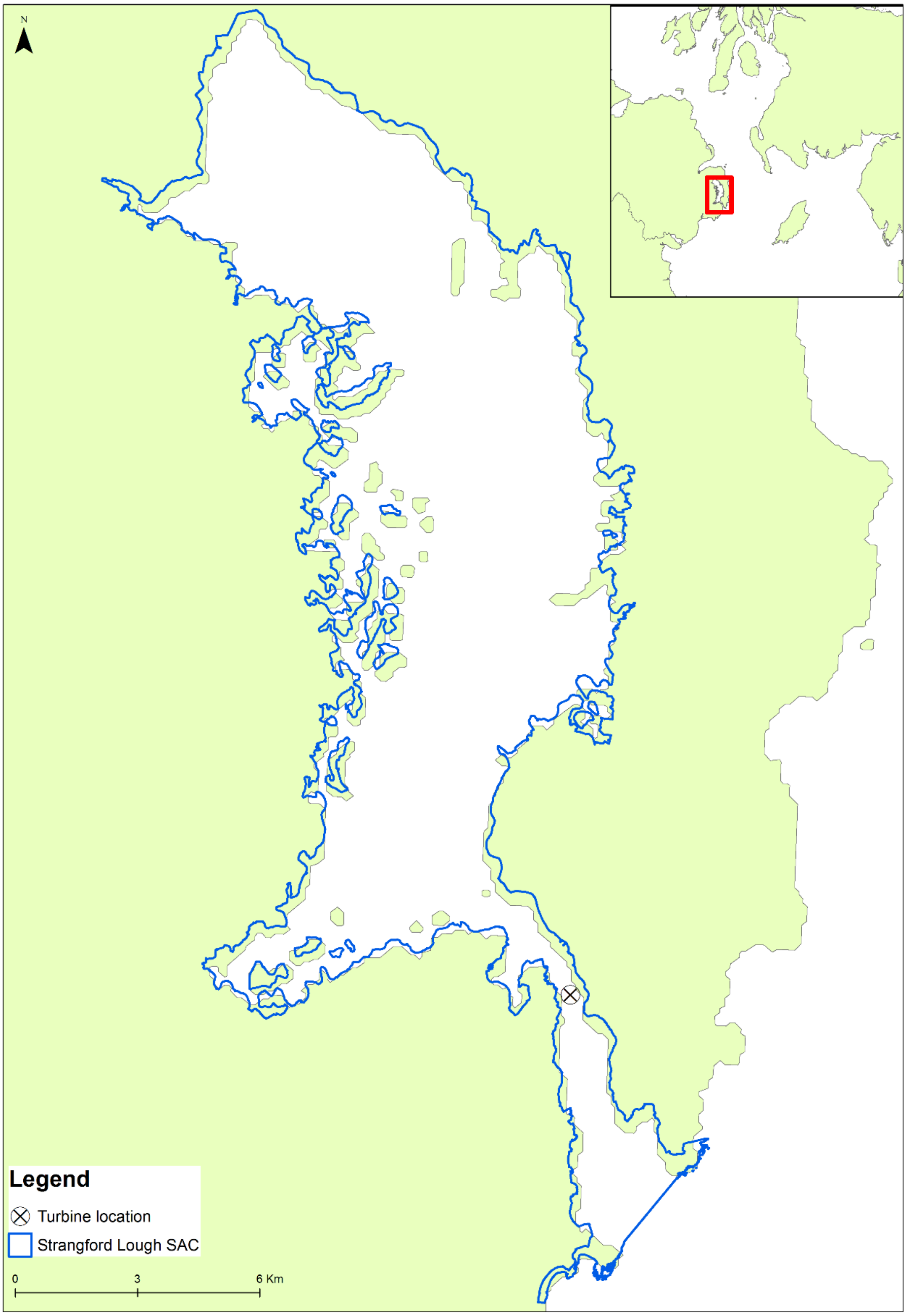
Site	Reason for Designation
	• Shelduck *Tadorna tadorna.*
Strangford Lough Ramsar	The site qualifies under Criterion 3a by regularly supporting over 20,000 waterfowl in winter. The five-year winter peak mean for the period 1992-93 to 1996-97 was approximately 70,200 waterfowl, comprising 48,700 waders and 21,500 wildfowl.
Strangford Lough ASSI (Parts 1, 2, and 3)	Part 1 - extensive mudflats and also sandflats, saltmarsh and rocky intertidal habitat. Part 2 - representative areas of a large number of intertidal habitats ranging from soft mudflats to steeply faced bedrock. Part 3 - extensive mudflats, saltmarsh and other types of shoreline habitat occur, including The Dorn NNR, a unique and exceptionally important site for intertidal flora and fauna.

Of the designated areas that were considered in the table above the ones that have been scoped in for assessment were Strangford Lough SAC, Strangford Lough MCZ, and the Shellfish Water Protected Areas. All other sites were reviewed within the SeaGen Decommissioning Scoping Report (MarineSpace, 2016) and it was concluded that they would not be impacted by the SeaGen decommissioning process.

12.1. Strangford Lough SAC

The area of the Strangford Lough SAC is shown in Figure 12.1.

Figure 12.1: Strangford Lough SAC boundary with the SeaGen position shown



Some of the benthic habitats within the region are designated as part of the Strangford Lough SAC. The benthic habitats for which Strangford Lough SAC has been designated include various subfeatures of Annex I reef and large shallow inlets or bays (JNCC, 2016):

Large shallow inlets and bays – Strangford Lough is an example of a large, enclosed fjordic sea lough. Sea water enters the Lough through a narrow entrance, expanding into a broad, mostly shallow basin that has a central deep channel (30-60m deep), which carries rapid currents and causes great turbulence in some parts, particularly the Narrows. As a result of this there is a diverse range of marine fauna within Strangford Lough. Benthic communities range from rich high-energy communities to communities in extreme shelter where fine muds support burrowing brittlestars, Dublin Bay Prawn *Nephrops norvegicus*, and a rich community associated with Horse Mussels *Modiolus modiolus*.

Mudflats and sandflats not covered by seawater at low tide – The intertidal mudflats and sandflats in the north of Strangford Lough represent the largest single continuous area of such habitat in Northern Ireland.

The habitat also occurs in the southwest reaches of the Lough. The northern flats support beds of the eelgrasses *Zostera noltei* and *Z. angustifolia*. Common Eelgrass *Z. marina* and Tasselled Pondweed *Ruppia maritima* are also present. Such extensive beds are rare in the British Isles.

Many of the invertebrate species present in muds also occur in muddy sand. However, lugworm *Arenicola marina* and nereid worms are generally dominant, along with bivalve molluscs such as *Angulus tenuis*, *Mya arenaria* and *Cerastoderma edule*.

Coastal lagoons – The ‘Dorn’ is a silled lagoon on the eastern side of Strangford Lough in Northern Ireland. The Dorn, refers specifically to the channel which connects several exceptionally sheltered bays to the main area of Strangford Lough. Near the mouth there are saltwater rapids, unique in Ireland. In the area of the Dorn rapids, there are abundant sea anemones, sponges and ascidians on the rock and boulders. Several of the animals found in the area of the rapids normally occur in relatively deep water. The main trough of the Dorn supports a dense forest of Sugar Kelp *Laminaria saccharina* and Sea-oak *Halidrys siliquosa*. The gravelly-sand bottom has dense colonies of Peacock Worm *Sabella pavonina* and Sand Gaper *Mya arenaria*. The channel immediately above the sill has fast tidal streams but no turbulence, which enables sponges to grow to large sizes.

Reefs – Reefs in Strangford Lough vary from tide-swept bedrock and large boulders in the main channel of the Narrows, through sand-scoured bedrock and boulders at either end of the channel, to more sheltered bedrock and boulders in the main central portion of the Lough and in parts of the intertidal. Beds of Horse Mussels *Modiolus modiolus* form biogenic reefs within the central portion of the Lough.

Harbour seals – this species is a qualifying feature, but not a primary reason for site selection for the Strangford Lough SAC. Strangford Lough is considered to support a significant presence.

Table 12.2: Summary of Strangford Lough SAC features and the size/extent of each

Feature	Estimated size/extent of feature (km^2)	Subfeature
Large shallow inlet and bay	150.9	Subtidal sand and gravel communities
		Subtidal fine sand and mud communities
		Tide swept communities
Coastal lagoons	0.45	Tide swept communities
Mudflats and sandflats not covered by seawater at low tide	20	Intertidal sand and gravel communities
		Intertidal fine sand and mud communities
		Zostera beds
Reefs	50	Subtidal rock and boulder communities
		Subtidal rocky reef communities
		Intertidal rock and boulder communities
		Modiolus modiolus beds – biogenic reefs

12.2. Strangford Lough MCZ

The Marine Act (Northern Ireland) 2013 includes provisions for establishing Marine Conservation Zones (MCZs), as well as a system of marine planning, fisheries management and marine licensing. MCZs may be designated for various purposes including the conservation of marine species and habitats. Strangford Lough was originally Northern Ireland's only Marine Nature Reserve (MNR) but it was re-designated as Northern Ireland's first MCZ on the introduction of the Marine Act in 2013.

The following features are designated within the Strangford Lough MCZ:

- Low energy circalittoral (subtidal) rock;
  - Estuarine rocky habitats;
- Sublittoral (subtidal) biogenic reefs;
  - Horse Mussel (*Modiolus modiolus*) beds;
  - Blue Mussel (*Mytilus edulis*) beds;
  - Brittlestar beds;
- Sublittoral (subtidal) muds;
  - Circalittoral sand and gravel communities;
  - Tide-swept channels;
  - Native oyster (*Ostrea edulis*) beds;
  - Brittlestar beds;
- Sublittoral (subtidal) mixed sediments;
  - Brittlestar beds.

12.3. Shellfish Water Protected Areas

There are three Shellfish Water Protected Areas within Strangford Lough:

- Reagh Bay/Paddy's Point;
- Marlfield Bay; and
- Skate Rock.

The locations of each of these areas can be seen in

Figure 12.2. The designated Shellfish Water area at Reagh Bay/Paddy’s Point is not currently in production.

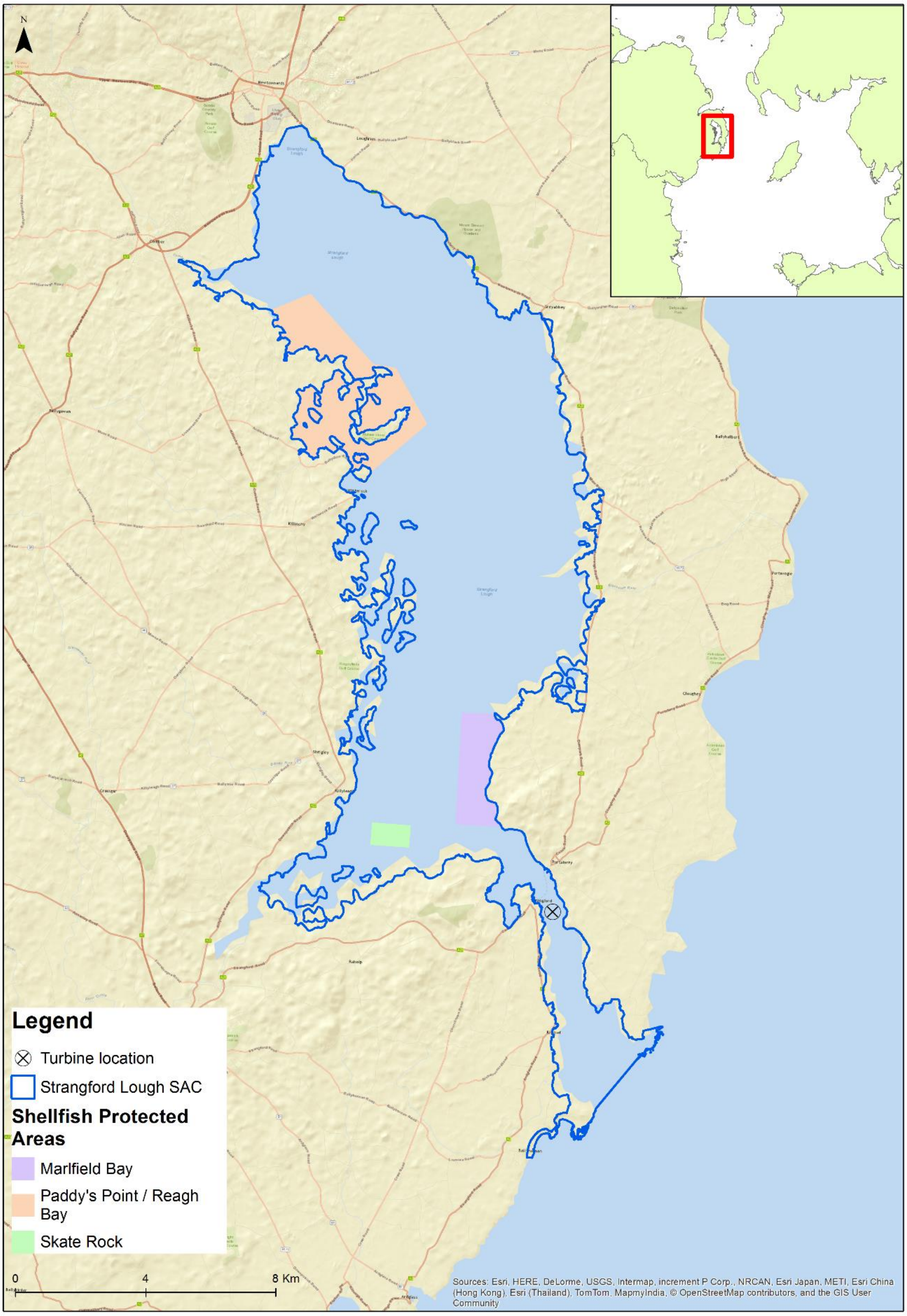
Water bodies can be impacted by pollution from various sources, such as run-off from agricultural land or discharges from sewage treatment works. Shellfish Water Protected Areas are areas designated for the protection of shellfish growth and production. Good water quality is important for the production of high quality shellfish.

Shellfish Water Protected Areas are designated under the Water Framework Directive (WFD). The WFD established a legal framework for the protection, improvement and sustainable use of Europe’s water environment. This has been taken forward through the introduction of River Basin Management Plans.

Within the River Basin Management Plan Structure, shellfish waters that were already existing have now become Water Framework Directive Protected Areas, for the protection of economically significant aquatic species.

The closest Shellfish Water Protected Area to the SeaGen device is Marlfield Bay, which is 3km away. Skate Rock is 5 km away, and Reagh Bay/Paddy’s Point is 15 km distance.

Figure 12.2: The location of Shellfish Water Protection Areas within Strangford Lough (Source: DAERA, 2015)



12.4. Nature Conservation Impact Assessment

12.4.1. Loss of Designated Seabed Habitat

The impacts of loss or damage of benthic habitats through use of JUV or MB was assessed in Section 7.3.1.

The total area of benthic habitat that will be impacted by each deployment of the JUV is 40 m^2, which represents a negligible amount of seabed compared with the entire Strangford Lough SAC area (153.9 km^2). The worst case scenario is that the JUV taking 10 attempts to find a suitable position, which would result in a total seabed footprint of 400 m^2, which is 0.0006% of the entire Strangford Lough SAC. Therefore, the effect upon benthic habitats within the Strangford Lough SAC will be extremely small in comparison to the larger area even in the worst case scenario.

The maximum estimated footprint of seabed impact for all anchors and chain catenary, for a large MB removing all four SeaGen legs is approximately 4,171 m^2. This footprint is 0.006% of the entire Strangford Lough SAC area.

The decommissioning operations are expected to be conducted over three weeks. Therefore, the impacts from the anchors will occur over a short period of time and are reversible. Following this, the seabed will be undisturbed and the impacted areas of seabed will be able to recover from the disturbance.

As a result of the small area of designated seabed habitat that could be impacted by the anchor from MB or JUV, the short duration of the decommissioning process, the natural disturbance within the area, and the rapid recovery observed during the benthic monitoring it is concluded that the **impact on benthic communities associated with designated features of the Strangford Lough SAC due to the use of MB or JUV will be negligible.**

12.4.2. Underwater Noise Disturbance to Harbour Seal

The possible impacts of noise generated through use of cold-cutting techniques (DWCT or AWJ), hot-cutting techniques, or MB or JUV on harbour porpoise in Strangford Lough was assessed in Section 9.2.2. It was concluded that due to the low potential for disturbance, the lower numbers of marine mammals around at the time of year, and infrequent nature and short duration of the activities, that the use of **cutting tools or vessel noise will result in a negligible impact on harbour porpoise as a designated feature of Strangford Lough SAC**.

12.4.3. Impacts on Shellfish Water Protection Area (Release of Contaminants)

Strangford Lough falls into the North Eastern River Basin District (RBD) of Northern Ireland and within this district it is in the Strangford Local Management Area. The surface water quality for Strangford Lough is listed as “moderate” within the River Basin Management Plan with a 2021 objective of achieving good / moderate status (NIEA, 2015).

The decommissioning operations are expected to be conducted over three weeks. The proposed AWJC technique may release contaminants and particulates during the decommissioning process.

These cuts may result in grout and concrete particulates being released. However, the works will result in a short-term (hours), localised (10s and 100s of metres from works) increase in particulates in the area of the works, which will be dispersed rapidly within the tidal waters

It is expected that any plume released during AWJC will include minimal levels of contaminants. In addition, the Shellfish Water Protected Areas are a considerable distance from the SeaGen device, with the closest area being more than 3 km away. Therefore, it is unlikely that any of the existing small quantities of grout and concrete released into the water will interact with the Shellfish Water Protected Areas.

Based on the above, non-temporary deterioration of WFD status is not likely to occur and the North Eastern River Basin District will not be prevented from achieving their WFD objectives for the Shellfish Water Protected Areas. The **impacts of AWJC upon Shellfish Water Protected Areas are predicted to be negligible.**

13. Human Environment

13.1. Commercial Fisheries

Commercial fishing in Strangford Lough has declined rapidly in recent years. Concerns that the use of mobile fishing gear was causing severe damage to the seabed and, in particular, to the *Modiolus* reefs, has led to a temporary total ban of dredging and trawling within the lough (Royal Haskoning, 2005).

Within Strangford Lough there is a low risk of conflict between fisheries and the SeaGen decommissioning procedure as the only fishing permitted within the lough is potting. Potting only occurs in water less than 10 m deep in the Narrows. Pot fishing within the lough is for edible crab *Cancer Pagurus*, shore crab *Carcinus maenas*, velvet swimming crab *Necora puber*, lob*omarus gammarus*, whelk *Buccinum undatum*, and Dublin Bay prawn *Nephrops* spp. The *Nephrops* fishery is one of the largest in Northern Ireland in both volume and value; the majority of those crustaceans caught are by trawlers outside of the lough but a few tonnes each year are caught by creel fishing within Strangford Lough.

The total County Down inshore fishery (which includes Strangford Lough) is worth about £5m per annum and relates to 1-2 man operations using small nets and pots within a few miles of the coast (Strangfordlough.org, 2014).

Recreational angling also occurs within Strangford Lough with many chartered boats available to be hired for the purpose of fishing within the Lough.

13.2. Commercial Fisheries Impact Assessment

13.2.1. Obstruction to Movement

13.2.1.1. Jack-up Barge

JUVs may be used during decommissioning of the SeaGen device as a platform from which to perform cutting methods. The presence of a JUV has the potential to cause obstruction to movement of fishing vessels within Strangford Lough.

The decommissioning process may require a JUV for the entire decommissioning process. The decommissioning operations are expected to be conducted over three weeks. Therefore, the total amount of disturbance time to fishing vessels will be limited by up to three weeks. This impact is therefore short-term and temporary and will not have a lasting impact on the ability for fishing vessels to move and fish within the area.

It is likely that any fishing vessels present within the vicinity of the SeaGen device during the decommissioning process will be able to avoid this area. There is a large amount of area available to fishing vessels within Strangford Lough.

As a result of the above information it is concluded that **the impact of obstruction by JUV to movement of fishing vessels is small-scale, temporary, and therefore negligible.**

13.2.1.2. Moored Barge

MBs may be used during decommissioning of the SeaGen device as a platform from which to perform cutting methods. The presence of MBs has the potential to cause obstruction to movement of fishing vessels within Strangford Lough.

The decommissioning process may require a MB for the entire decommissioning process. The decommissioning operations are expected to be conducted over three weeks. Therefore, the total amount of disturbance time to fishing vessels will be limited by up to three weeks. This impact is therefore short-term and temporary and will not have a lasting impact on the ability for fishing vessels to move and fish within the area.

It is likely that any fishing vessels present within the vicinity of the SeaGen device during the decommissioning process will be able to avoid this area. There is a large area available to fishing vessels within Strangford Lough.

As a result of the above information it is concluded that the **impact of obstruction to movement of fishing vessels by MBs is small-scale, temporary, and therefore negligible.**

13.2.2. Introduction of Non-native Species

13.2.2.1. Diamond Wire

In the event that there are any invasive non-native species present on the SeaGen device the process of decommissioning has the potential to facilitate the spread of these species. A major concern is the potential spread of the nvasive non-native species, the Carpet Sea Squirt *Didemnum vexillum*, within Strangford Lough during decommissioning.

D. vexillum has been known to have negative impacts on benthic communities in areas where it has been recorded in the past. In particular, *Didemnum vexillum* can impact aquaculture industries through smothering structures and shellfish (Payne *et al*., 2014). In addition, *D. vexillum* can also have negative effects on benthic habitats and species through smothering and alteration of CO_2 budget (Dupont *et al*., 2008; Gittenberger, 2007).

The use of a DWCT on the SeaGen structure could result in the release of *D. vexillum* from SeaGen into the surrounding marine environment if the tool were to cut directly through the organism or if the organisms were shaken loose due to structural vibration. If the *D. vexillum* was able to survive and settle it could potentially result in the spread of the species within Strangford Lough.

D. vexillum has not been identified as present upon SeaGen's subsurface during the monitoring surveys that have been conducted (Royal Haskoning, 2011). In addition, a targeted drop-down video search conducted during summer 2016 did not record any *D. vexillum* or other invasive non-native species as present. As a result, it is considered unlikely that there will be any *D. vexillum* present upon the SeaGen structure during decommissioning. *D. vexillum* only produces larvae at temperatures greater than 14^{o}C, so typically during summer and autumn (Griffith *et al.*, 2009) and the SeaGen decommissioning process will take place during the winter months, thereby mitigating the potential for larval dispersion.

As a result of the low likelihood of invasive non-native species being present on the SeaGen structure, and the fact that the decommissioning process will be conducted during the winter months when larval dispersal of *D. vexillum* does not occur, the likelihood of non-native species being introduced to other areas of Strangford Lough is low. Therefore, **the impact of the use of a DWCT on the spread of invasive non-native species is considered to be negligible**.

13.2.2.2. Abrasive Water Jet

The use of an AWJC on the SeaGen structure may result in the release of any *D. vexillum* or other invasive non-native species present into the surrounding marine environment. If the *D. vexillum* is able to survive and settle it could potentially result in the spread of the species within Strangford Lough.

D. vexillum has not been identified as present upon SeaGen's subsurface during the monitoring surveys that have been conducted (Royal Haskoning, 2011). In addition, a drop down video search conducted during summer 2016 did not record any *D. vexillum* or other invasive non-native species as present. As a result, it is considered unlikely that there will be any *D. vexillum* present upon the SeaGen structure during decommissioning. *D. vexillum* only produces larvae at temperatures greater than 14^{o}C, so typically during summer and autumn (Griffith *et al.*, 2009) and the SeaGen decommissioning process will take place during the winter months, thereby mitigating the potential for larval dispersion.

As a result of the low likelihood of invasive non-native species being present on the SeaGen structure, and the fact that the decommissioning process will be conducted during the winter months when larval dispersal of *D. vexillum* does not occur, the likelihood of non-native species being introduced to other areas of Strangford Lough is low. Therefore, **the impact of the use of an AWJ on the spread of invasive non-native species is considered to be negligible.**

14. Cumulative impact assessment

Environmental impacts arising from the decommissioning procedures for the SeaGen device described within this ES have the potential act cumulatively with those resulting from other seabed user activities within Strangford Lough.

The potential cumulative impacts from foreseeable plans and projects within Strangford Lough that are to be considered are:

- Commercial fisheries;
- Navigation; and
- Minesto tidal device – Strangford Lough demonstration site.

14.1. Commercial Fisheries

Commercial fishing activities and decommissioning procedures conducted upon the SeaGen device have the potential to have cumulative impacts through physical disturbance upon benthic communities, and in particular the benthic features of the Strangford Lough SAC.

Section 12.4.1 describes the potential for the decommissioning of the SeaGen device to impact upon the benthic features of the Strangford Lough SAC and result in loss of designated seabed habitat. The assessment concluded that the overall impact from JUV and MBs on the benthic habitats would be **minor adverse**.

Commercial fishing in Strangford Lough has declined rapidly in recent years. Concerns that the use of mobile fishing gear was causing severe damage to the seabed and, in particular, to the *Modiolus* reefs, has led to a temporary total ban of dredging and trawling within the Lough (Royal Haskoning, 2011). Therefore, the only commercial fisheries that are conducted within the area is potting for crustaceans and shellfish species; this activity does not result in the loss of seabed habitat.

Therefore, the cumulative impacts of the SeaGen decommissioning procedures and commercial fisheries that occur within Strangford Lough are **negligible**.

14.2. Shipping and Mobile Marine Fauna

The increase in vessel activity during the SeaGen decommissioning procedure has the potential to impact upon mobile marine fauna that use Strangford Lough, such as fish species (including basking shark) and marine mammals.

Basking shark and marine mammals are mobile and able to move away from areas where the visual presence of the vessels may cause disturbance. However due to the short time frame of this impact the magnitude of the impact will be minor. It is expected that once the decommissioning vessels have left the affected species may return to the area, so any impact caused due to noise and visual disturbance will be short-term and temporary.

Commercial shipping traffic through the Narrows is extremely low and there is ample room to navigate around any decommissioning works (Marico Marine, Marine and Risk Consultants Ltd, 2016).

Therefore, the cumulative impact of noise from shipping and decommissioning activities on mobile marine fauna is considered to be **negligible**.

14.3. Minesto Tidal Device

The Minesto tidal power device within Strangford Lough is a new concept for tidal power plants known as Deep Green. This technology has the ability to operate in low tidal velocities. The Minesto device within Strangford Lough is located within a demonstration site (Minesto, 2016). The device was installed in the Lough in 2014 and is currently still in place.

There are currently no plans to remove the Minesto device and therefore decommissioning for the Minesto device will not coincide with the decommissioning of SeaGen. Therefore, it is concluded that there will be **no cumulative impact** of SeaGen decommissioning with the Minesto tidal device.

15. Information to Inform HRA

Potential impacts on the benthic habitats of Strangford Lough were assessed as part of the EIA. These assessments provide sufficient evidence to facilitate an HRA for possible impacts upon the following nature conservation features within the Strangford Lough SAC:

- Large shallow inlet and bay;
- Coastal Lagoons;
- Mudflats and sandflats not covered by seawater at low tide;
- Reefs;
- Annual vegetation of drift lines;
- *Salicornia* and other annuals colonizing mud and sand;
- Atlantic salt meadows (*Glauco-Puccinelietalia maritimae*); and
- Perennial vegetation of stony banks.

Designated for the presence of the following Annex II species:

- Harbour seal *Phoca vitulina.*

Potential loss or damage of benthic habitat within the Strangford Lough SAC is assessed in Section 8.2.1. It is estimated that there will be a small amount of designated Annex I habitat impacted by the feet of the JUV or the anchor of the MB. The maximum seabed that will be impacted is 400 m^2 for JUVs, which is 0.0006% of the entire Strangford Lough SAC designated area or 4,171 m^2 for MBs, which is 0.006% of the SAC. The benthic surveys conducted as part of the pre-construction ES, and monitoring during the SeaGen project, have shown that the benthic habitats and communities within the Narrows have shown high levels of recoverability to baseline levels, so any disturbance will be short-term and reversible. This is due to the natural disturbance within the Narrows area, often resulting in the movements of large boulders around the seabed, which will disturb patches of the benthos, keeping the communities of the Narrows boulder field in a constant state of succession (Royal Haskoning, 2011). Therefore, any damage caused to the Strangford Lough SAC features will be short-term, temporary and reversible.

The possible impacts of noise generated through use of cold-cutting techniques (DWCT or AWJ), hot-cutting techniques, or MB or JUV on harbour seal in Strangford Lough was assessed in Section 9.2.2. It was concluded that due to the low potential for disturbance, the lower numbers of marine mammals around at the time of year, and infrequent nature and short duration of the activities, that the use of cutting tools or vessel noise will result in a negligible impact on harbour seal as a designated feature of Strangford Lough SAC. Furthermore, no major impacts were detected across the three years of post-installation monitoring (Royal Haskoning, 2011). Any changes observed during installation were shown to be short-term and reversible.

It is therefore suggested that the decommissioning of the SeaGen device will produce no likely significant effect on the designated features of the Strangford Lough SAC.

15.1. In-combination

The assessment conducted above in Sections 8-13 and in the Cumulative Impact Assessment in Section 14 can be used to inform the in-combination impact assessment for the HRA. All of the impacts assessed for the decommissioning of the SeaGen structure have been concluded to be **negligible**. Therefore, it is advised that there will be no likely significant effect on the features or the integrity of the Strangford Lough SAC site as a result of in-combination impacts with the SeaGen decommissioning procedures.

16. Summary and Conclusions

The impacts discussed in the preceding chapters are summarised in Table 16.1.

Table 16.1: Summary of potential impacts of SeaGen decommissioning

Potential Impact	Magnitude	Duration	Overall Impact
Loss or damage of benthic habitat of the Narrows	Minor (up to 4,171 m^2)	Short-term (3 weeks)	**Negligible**
Damage to other benthic SAC features	Minor (up to 4,171 m^2)	Short-term (3 weeks)	**Minor adverse**
Impact on fish species due to noise and vibration	Negligible, localised	Short-term (up to 90 hours)	**Negligible**
Impact on basking shark due to noise and visual disturbance	Negligible, localised	Short-term (3 weeks)	**Negligible**
Noise disturbance and injury to pinnipeds	Negligible	Short-term	**Negligible**
Noise disturbance and injury to cetaceans	Negligible	Short-term	**Negligible**
Introduction of non-native species	Negligible, no non-native species identified as present	Short-term (up to 90 hours)	**Negligible**
Impacts on Shellfish Water Protected Areas	Negligible	Short-term (up to 90 hours)	**Negligible**
Cumulative impact with commercial fisheries	Minor	Short-term (3 weeks)	**Negligible**
Cumulative impact of shipping on mobile marine fauna	Negligible	Short-term (3 weeks)	**Negligible**
Cumulative impact with Minesto tidal device	None	Short-term (3 weeks)	**No impact**

Table 16.2: Summary of potential SeaGen decommissioning mitigation

Potential impact	Mitigation Measures
Loss or damage of benthic habitats	None required
Loss of designated seabed habitat	None required
Impact on fish species due to noise and vibration	None required
Noise and visual disturbance to basking shark	None required

Noise disturbance and injury to pinnipeds	Activities taking place during Jan to March when abundance of marine mammals is low. Additional possible mitigation options in relation to use of AWJC will be discussed with the regulator if considered necessary.
Noise disturbance and injury to cetaceans	Activities taking place during Jan to March when abundance of marine mammals is low. Additional possible mitigation options in relation to use of AWJC will be discussed with the regulator if considered necessary.
Introduction of non-native species	Decommissioning operations will take place between January and March when there is no larval recruitment of *Didemnum vexillum*
Collision between vessels and marine mammals	Activities taking place during Jan to March when abundance of marine mammals is low. Maximum vessel speeds implemented (maximum speeds of 14 kts with a reduction to 6 kts if any marine mammals are sighted).
Impacts on Shellfish Water Protected Areas	None required
Cumulative impact with commercial fisheries	None required
Cumulative impact of shipping on mobile marine fauna	None required
Cumulative impact with Minesto tidal device	None required

Due to the impact assessments that have been conducted upon the potential receptors for decommissioning the SeaGen process the following overall conclusions have been made:

- Decommissioning of the SeaGen device will result in some short-term and temporary impacts upon benthic communities in Strangford Lough via loss or damage of seabed habitat through use of moored barge or jack-up vessel;
- No adverse effect on site integrity of Strangford Lough SAC and less than 0.01% will experience short-term temporary impacts via loss or damage of designated seabed habitat through use of moored barge or jack-up vessel;
- Short-term and temporary impacts upon fish, including basking shark, pinnipeds and cetaceans, due to noise disturbance through use of DWCT or AWJ;
- Impacts on all other receptors are considered to be negligible;
- No cumulative impacts with commercial fisheries, shipping and the Minesto tidal device; and
- Decommissioning of the SeaGen device is not predicted to result in any medium to long-term environmental impacts.

It is the conclusion of the EIA that following mitigation there will be no major adverse residual impacts either from the project alone or cumulatively with other projects on any environmental receptors within Strangford Lough.

Information has also been provided within the ES to facilitate HRA for the possible impacts of the project upon the nature conservation features of Strangford Lough. It is predicted that the project alone, and in combination with other plans and projects, will result in no likely significant effect on the European sites of Strangford Lough.

17. References

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Appendices