SCOTTISH MARINE RENEWABLES SEA

ENVIRONMENTAL REPORT

SECTION A: INTRODUCTION, BACKGROUND AND METHOD

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SCOTTISH EXECUTIVE

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Note: This document is only a section of the Final Environmental Report

Scottish Marine Renewables SEA
Environmental Report Section A: Introduction, Background and Method

Scottish Executive
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A1 Introduction

A1.1 Introduction

Commissioned by the Scottish Executive, this Environmental Report has been produced as part of the Strategic Environmental Assessment (SEA) for the development of wave and tidal stream devices (marine renewables) off the west and north coast of Scotland. This Environmental Report presents the findings of the SEA and provides recommendations for future monitoring.

In 2004 a report "Harnessing Scotland's Marine Energy Potential" prepared by the Marine Energy Group (MEG) identified that up to 10% of Scotland's electricity generation (about 1,300 megawatts, MW) could come from wave and tidal stream power by 2020. As such, this would contribute significantly to the Scottish Executive's target of generating 40% of its electricity from renewable sources by 2020.

The Scottish Executive commissioned this Strategic Environmental Assessment (SEA) to examine the environmental effects of developing wave and tidal power and to use the results to inform the preparation and delivery of the Scottish Executive's strategy for the development of marine energy.

In addition to informing the development of the Scottish Executive's strategy for marine energy, the results of the SEA will also be used to inform the development of planning guidance for wave and tidal energy developers. The information collated during the SEA will be a reference source for use by regulatory authorities and key stakeholders to support decision-making at project-level on future marine renewable energy developments.

A1.2 The Project

The SEA was carried out to assess, at strategic level, the potential environmental effects of the development of wave and tidal devices off the west and north coast of Scotland.

The study area that has been covered by the SEA includes (out to 12 nautical miles):

- Western Seaboard of Scotland (including the Solway Firth, North Channel, Argyll and Bute, Inner Isles, Western Isles and Outer Isles)
- Pentland Firth and North Coast
- The Northern Isles (Orkney and Shetland)

The SEA study area is illustrated in Figure A1.1**.** An explanation as to how the study area was identified is provided in Chapter A2: Project Description. Note that the study area excludes the east coast of Scotland.

The main objectives of the SEA are:

- To assess, at a strategic level, the potential effects on the environment of meeting or exceeding the Marine Energy Group (MEG) report's estimate for establishing 1,300MW of marine renewable energy capacity around Scotland by 2020;
- To advise and support the Scottish Executive in the development and implementation of its strategy for marine renewable energy and informing future development of planning guidance for marine developers;
- To inform the project-level decision-making process for all stakeholders (to include regulators and developers); and
- To facilitate focused investment into the marine renewable energy sector in Scotland.

In the context of this SEA, 'marine renewables' refers to wave and tidal devices only. Off-shore wind and tidal barrage devices have been excluded in this SEA. Reasoning behind these exclusions are discussed in Chapter A2: Project Description.

Based on the above objectives, the main deliverables of the SEA process are:

- Establishment of the baseline situation based on available information;
- Identification of gaps and inconsistencies in the baseline data and the need for further survey work or study;
- Consultation (to be undertaken continuously, at varying levels, throughout the project);
- Assessment of the effects of the marine renewable devices on the marine environment;
- Recommendation of mitigation measures to avoid, reduce or offset any significant adverse effects on the environment;
- Documentation of the findings from the SEA (Scoping and Environmental Reports which meet the requirements of the SEA Directive; public consultation documents; and internal discussion papers);
- Advice and support to the Scottish Executive in the preparation and implementation of its strategy for marine energy and planning guidance for marine development; and
- Advice on the scope of potential monitoring requirements and providing a web-based information resource.

The SEA has been guided by a Steering Group, with representatives drawn from a broad range of stakeholders (see Appendix A1.1).

Note: This SEA is not being carried out for the licensing of potential sites, as was the case with the England and Wales offshore wind licensing 'Round 2'.

It is also important to note that this SEA reflects policy, sector, device and baseline information available in the public domain as of November 2006.

A1.3 Structure of the Environmental Report

To make the report more manageable and easily digestible, it has been split into 6 separate documents. These documents, referred to as Environmental Report Sections, include:

- **Non-Technical Summary**

- Environmental Report **Section A**: Introduction, Background and Method
  - Chapter A1: Introduction
  - Chapter A2: Project Description
  - Chapter A3: Scoping Summary
  - Chapter A4: Assessment Method

- Environmental Report **Section B**: Technology and Resource (Wave and Tidal)
  - Chapter B1: Marine Resource Areas
  - Chapter B2: Device Information
  - Chapter B3: Development Size Assumptions

- Environmental Report **Section C**: 'Level 1' Assessment
  - Chapters C1 to C21: Results of environmental assessment by SEA topic including 'significance' maps (GIS Maps)

- Environmental Report **Section D**: Energy Resource Assessment and Cumulative Effects
  - Chapter D1: Introduction
  - Chapter D2: Level 1 Assessment – Conclusions
  - Chapter D3: Energy Resource Assessment
  - Chapter D4: Cumulative Effects

- Environmental Report **Section E**: Informing the Future Development of Marine Energy
  - Chapter E1: Introduction
  - Chapter E2: Informing the Future Development of Marine Energy
  - Chapter E3: Site Specific Surveys
  - Chapter E4: Monitoring Framework
  - Chapter E5; Next Steps

To supplement the information that was available in the public domain as of November 2006, four additional studies were commissioned by the Scottish Executive to inform the Level 1 Assessment (results present in Section C of the Environmental Report). These Additional Studies, listed below, are presented as appendices to the main Environmental Report, and are available for download from the SEA website (www.seaenergyscotland.co.uk)

- Munitions Contamination of Marine Renewable Energy Sites in Scottish Waters: A Study for the Scottish Executive, QinetiQ, January 2007 (Appendix C4.A)
- Collision Risk between Energy Devices and Mammals, Fish and Diving Birds, Scottish Association for Marine Science, February 2007 (Appendix C7.B)
- Study 3: Shipping and Navigation, Marine and Risk Consultants Limited, February 2007 (Appendix 15.A)
- Underwater Noise Study Supporting Scottish Executive Strategic Environmental Assessment of Marine Renewables, Quinetiq, January 2007 (Appendix C17.A)

The Scoping Report (February 2006), which set the context for the SEA and was used to confirm the scope of this SEA with the statutory consultees and other key stakeholders, is also available for download, along with this Environmental Report, from the SEA website: http://www.seaenergyscotland.co.uk/

A1.4 Introduction to Renewable Energy

The Kyoto Protocol, adopted in 1997, and recently entered into force on the 16th February 2005, is the landmark treaty designed to reduce the emission of greenhouse gases. Under the Kyoto Protocol, the UK has set targets to reduce greenhouse gas emissions by 12.5% against 1990 levels by 2008-12. The UK Government also aims to reduce CO_2 emissions by 20% by 2010.

EU Directive "The Promotion of Electricity from Renewable Energy Sources in the Internal Electricity Market" (2001/77/EC), otherwise known as the Renewables Directive, requires each member state to commit to specific targets for renewable energy. The Directive requires that each country adopts national targets for renewables that are consistent with reaching the commission's target of 22% of electricity from renewables set out in the EU White Paper "Energy for the Future: Renewable Source of Energy 1997".

UK Climate Change Programme, published in November 2000, sets out how the UK Government will meet the targets set under the Kyoto Protocol of 12.5% reduction in Greenhouse Gases by 2012. It also sets out proposals for moving towards a domestic reduction in CO_2 emissions of 20% by 2010 and for producing 10% of the UK's electricity from renewable by 2010 in line with the EU Renewable Directive.

The Energy White Paper "Our energy future – creating a low carbon economy", issued in February 2003 sets out the UK Government's aims to achieve its long-term goal to reduce UK carbon emission by 60% by 2050. This goal became legally binding under the Climate Change Bill (Draft) issued in March 2007. The White Paper identifies that renewable energy is integral to achieving a 60% reduction in CO_2 emissions by 2050, outlining the Government's commitment to increasing the proportion of electricity generated by renewable energy sources to 10% by 2010.

With regard to the development of offshore renewable energy resources, the Energy White Paper identifies that offshore wind would contribute significantly to the UK's target for 10% of electricity to be produced from renewable sources. Wave and tidal power is also identified as having an important role in meeting future targets. In July 2006 the UK Government published 'The Energy Challenge: Energy Review Report' which further recognises the importance of maximising the potential contribution from emerging technologies such as wave and tidal power.

The UK Energy White Paper acknowledged that the UK was moving towards becoming a net importer of energy, making it vulnerable to global forces and interruptions in supply. The EU White Paper also identifies the promotion of renewable energy as a high priority in the EU in terms of environmental protection and social and economic redevelopment.

A1.5 Background to Renewable Energy Policy in Scotland

A1.5.1 Policy Framework and Targets

Whilst energy policy and utility regulations are reserved matters, the promotion of renewable energy is executively devolved[1]. This allows the Scottish Executive to set its own targets for renewable energy.

The Scottish Executive's Climate Change Programme 2006: Changing Our Ways updates the original Climate Change Programme for Scotland 'Making it Work Together', produced in 2000. The Scottish Climate Change Programme (SCCP) 2006 sets out how the Executive will deliver its commitment to making equitable contributions to the UK's commitments on climate change, outlined above. The review of the original SCCP identified a need to strengthen accountability. Therefore, in the SCCP 2006, the Executive has developed an approach to quantify Scotland's equitable contribution in carbon terms. This approach is described as the Scottish Share.

The Scottish Share paves the way for setting a challenging and robust Scottish target. It is the amount of carbon 'savings' that Scotland has to deliver through its devolved policies to match savings from all devolved policies in the UK Climate Change Programme (UKCCP) on a per capita basis.

The Scottish Share equates to 1.7 million tonnes of carbon (mtc) in annual savings by 2010. This is based on policies in the UKCCP from 2000, policies introduced since 2004, and the new policies set out in the current UKCCP published in 2006. The Scottish Share does not directly relate to the achievement of targets and goals at a UK level and does not include the carbon impacts of reserved policies throughout the UK.

The actual target for Scotland is to exceed the Scottish Share by 1 million tonnes of Carbon in 2010. The SCCP 2006 identifies that this target will demonstrate the Executive's commitment to mitigating climate change and will help to stimulate action across all sectors of our society and economy. The development of an overarching target, which is based on policy impact, will allow at a glance, the Executive's commitment to tackling climate change to be assessed.

In terms of the energy sector, one of the main policy developments identified in the SCCP 2006 is to continue progressing towards achieving the Scottish Executive's target to generate 18% of Scotland's electricity from renewable sources by 2010, rising to 40% by 2020. The SCCP also identifies that this target should be delivered through as wide a range of technologies as possible.

The Renewables Obligation (Scotland), or ROS, is the mechanism by which the Scottish Government will achieve its renewable energy targets. It uses powers created by the Utilities Act 2000 and a market enabling mechanism, to place legal obligations on licensed electricity suppliers in Scotland to provide more of their electricity from renewable sources such as, wind, wave, tidal, hydro and biomass.

[1] Only the UK Government can pass laws on reserve matters. Reserve matters are defined in Schedule 5 of the Scotland Act. Devolved matters are those which have been transferred from Westminster to the Scottish Parliament.

Scottish Ministers are currently consulting on the proposal to introduce a Scottish Marine Supply Obligation (MSO) under the ROS, which will target support more directly at wave and tidal power technologies. This is in line with the recommendations for the UK Government's Energy Review Report 2006, which proposed amendment of the Renewables Obligation to provide additional support to emerging technologies. Following a period of statutory consultation, amendments to the ROS are expected to be brought into force in April 2007.

In addition to continuing development of its policy on renewable energy, the Scottish Executive, under the SCCP, is also revising its draft Scottish Planning Policy (SPP)6: Renewable Energy. When published in 2007, SPP6 will help guide the development of renewables installations.

Under the present guidance provided by NPPG6, existing consented renewable energy capacity is likely to be sufficient to meet the Scottish Executive's 2010 target. Superseding NPPG6, the intention of SPP6 will be to ensure the 2020 target is achieved in the most sustainable and environmentally acceptable manner. The current draft SPP6 recognises that emerging technologies may have the potential to contribute more significantly to the overall generation mix in the longer term. This will include technologies not covered by the land-use planning system including offshore wind, wave and tidal.

A1.5.2 Introduction to the Scottish Marine Renewable Programme

To help Scotland achieve its renewable energy generation targets, the Forum for Renewable Energy Development in Scotland (FREDS) was set up with a remit to identify the best ways to overcome barriers to the exploitation and development of renewable energy sources. FREDS established the Marine Energy Group (MEG) in October 2003 to assess the potential for developing wave and tidal energy in Scotland and to develop an action plan.

The MEG report "Harnessing Scotland's Marine Energy Potential" (2004) identified that the key to fulfilling Scotland's renewable energy potential lies with the development of new technologies, particularly (but not exclusively) wave and tidal power alongside established and already competitive technologies such as hydro and wind energy. MEG believes that, by 2020, 10% of Scotland's electricity can come from marine renewable sources and that there is opportunity for 1300MW of marine energy capacity to be installed in Scottish waters at an average rate of 100MW per year.

MEG also recognises the potential for Scottish-based marine energy companies to become major suppliers of international energy export markets and that 7,000 jobs could be created in the diverse marine energy industry. Ultimately, Scotland could become a world leader in research, development and certification of marine renewable energy devices.

The Scottish Executive recognises that, based on the findings of the MEG research, the development and exploitation of marine renewable energy sources will contribute significantly towards achieving Scotland's target of generating 40% of electricity from renewables by 2020. The MEG report represents the foundations of the Executive's developing strategy for marine energy.

A1.5.3 Scottish Coastal Forum (SCF) and Scottish Sustainable Marine Environment Initiative (SSMEI)

The Scottish Coastal Forum (SCF) was set up in November 1996 following publication of the Scottish Offices "Scotland's Coast – A Discussion Paper" in March 1996. This discussion paper was published in response to the report by the House of Commons Select Committee on Coastal Zone Protection and Planning (HMSO 1992).

The SCF was set up to give advice to ministers on policy issues relating to the coast. In 2000 the SCF identified a need for a management strategy for Scotland's Coast, a decision that was supported by publication of the "Integrated Coastal Zone Management: A Strategy for Europe" report (EC 2000) and a draft recommendation. The draft recommendation encourages member states to prepare national ICZM strategies and to report on progress after 2 years.

The "Strategy for Scotland's Coast and Inland Waters", published in 2004 sets out a framework for the sustainable use of Scotland's Costs and Inland Waters. The aims of the strategy are to take stock of the resources and key management issues and then, beyond the short term, to develop an influential vision based on a 25 year forward view.

The advice contained within the SCF strategy has been taken forward by the Scottish Executive in their publication of "Seas of Opportunity: A Strategy for the Long-Term Sustainability of Scotland's Coasts and Seas" in September 2005. This sets out a new Scottish marine and coastal strategy underpinned by high level objectives and specific action-focused targets. The strategy is being developed and taken forward by the Scottish Advisory Group on the Marine and Coastal Strategy (AGMACS) whose work will inform and enable decision-making by Scottish Ministers on important issues such as ICZM, marine spatial planning (as set out in the UK Marine Bill[2], responsibilities for which are devolved in Scotland) and science and monitoring.

In September 2005 the Scottish Sustainable Marine Environment Initiative (SSMEI) was launched. This initiative consists of a number of pilot studies around the Scottish coast whose aim is to trial new ways of managing the coastal and marine environment, including options for marine spatial planning and taking into account the principles of ICZM. These pilots are expected to report back in 2007.

A1.6 Environmental Protection

Both MEG (2004) and the Scottish Executive recognise that an SEA of Scotland's marine environment for tidal, wave (and offshore wind) technologies will play a critical role in facilitating the future commercial development of marine renewable energy devices in the Scottish waters. The findings of the SEA will be fed into the Scottish Executive's strategy for marine renewable energy to ensure that all environmental issues are taken into consideration and to inform the development of planning guidance for marine energy development.

A1.7 Strategic Environmental Assessment (SEA)

A1.7.1 The Environmental Assessment (Scotland) Act 2005

On the 20th July 2004 it became a legal requirement that, under the Environmental Assessment of Plans and Programmes (Scotland) Regulations 2004, all spatial plans and programmes are subject to an SEA. The 2004 UK (Scotland) Regulations transpose the requirements of European Directive 2001/42/EC "the assessment of the effects of certain plans and programmes on the environment" (the Strategic Environmental Assessment (SEA) Directive).

In 2005 the Scottish Executive established the Environmental Assessment (Scotland) Act. This Act, which came into force on 20th February 2006, replaces the Environmental Assessment of Plans and Programmes (Scotland) Regulations 2004 as the transposition vehicle for the SEA Directive. The Act delivers on the Partnership Agreement commitment to widen the scope of SEA, and go further than obliged by the SEA Directive, by including strategies as well as all public plans and programmes (PPS).

The main benefits of the SEA process as set out in the 2005 Act are as follows:

- SEA improves the information base for PPS preparation, providing clear information on the possible impact on the environment and influencing the preparation of the PPS, while building in better environmental protection and outcomes
- SEA provides a rigorous system for including environmental factors in decision-making, thus supporting a sustainable development approach
- SEA facilitates an improved consultation process, including the rigorous assessment of reasonable alternatives
- SEA also facilitates transparency, by requiring that an analysis of public comments is undertaken and made publicly available

[2] DEFRA 'A Sea of Change: A Marine Bill: White Paper' Department for Environment, Food and Rural Affairs', March 2007

- SEA facilitates the consideration of cumulative effects and provides a means to prevent, reduce and, as fully as possible, offset any potentially adverse environmental effects.

A1.7.2 Determining the Need for an SEA

The Scottish Executive's strategy for the development of marine energy was established before 20th February 2006. Therefore, the determination of need for an SEA fell under the initial Environmental Assessment of Plans and Programmes (Scotland) Regulations 2004. Under the 2004 Regulations, the plans and programmes requiring an environmental assessment are prescribed by the SEA Directive as those which:

- Are likely to have significant environmental effects
- Are prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use, and which sets the framework for future development consent of projects requiring an EIA or an 'appropriate assessment' in accordance to the Habitats Directive.
- Are subject to preparation and/or adoption by an authority at national, regional or local level or which are prepared by an authority for adoption, through a legislative procedure by Parliament or Government, and which are required by legislative, regulatory or administrative provisions.

The Scottish Executive's strategy for the development of marine energy falls under this definition as requiring a Strategic Environmental Assessment (SEA).

A1.7.3 Objectives of the SEA Directive

The objectives of the SEA Directive, as set out in Article 1, are "to provide a high level of protection to the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development". These objectives, which were reflected in the Environmental Assessment of Plans and Programmes (Scotland) Regulations 2004, formed the basis of the Scottish Marine Renewables SEA.

The objectives of SEA have since been expanded by the 2005 Act. Although the Scottish Marine Renewables SEA commenced prior to enforcement of the 2005 Act, the approach used has been subject to formal review to ensure that it achieves the objectives of the 2005 Act. The objectives of the SEA[3] as set out in the Environmental Assessment (Scotland) Act 2005 are:

- To provide a systematic means of identifying, describing, evaluating and reporting on the environmental effects of PPS
- To require Responsible Authorities (i.e. plan, programme or policy-makers) prepares a report on the likely significant environmental effects of the PPS and its reasonable alternatives
- To prevent, reduce and offset negative environmental effects. The enhancement of positive effects may also benefit from the SEA process
- To ensure wide consultation and engagement with the statutory Consultation Authorities, such as other bodies as the Responsible Authority considers appropriate (e.g. health), and the public at an early and effective stage of the PPS preparation
- To deliver a public statement demonstrating how the results of the environmental assessment and the opinions expressed during the SEA consultation process have been taken into account in a final adopted PPS
- To ensure that Responsible Authorities monitor the significant environmental effects of implementing their PPS, enabling them to also identify unforeseen adverse effects at an early stage and to take appropriate remedial action where necessary

[3] Strategic Environmental Assessment Toolkit: Natural Scotland (Scottish Executive) 2006.

A1.7.4 Requirements of the SEA Directive

The Strategic Environmental Assessment Toolkit: Natural Scotland (Scottish Executive) 2006 was published in response to enforcement of the 2005 Act. The SEA Toolkit sets out the requirements of the 2005 Act and provides guidance for its practical application within Scotland. It incorporates advice set out in the UK Governments main guidance note on SEA 'A Practical Guide to the Strategic Environmental Assessment Directive' (ODPM September 2005).

Given that the Scottish Marine Renewables SEA commenced prior to enforcement of the 2005 Act, the approach taken took advice from the initial ODPM guidance on SEA. However, a review of the SEA Toolkit was undertaken to ensure that the approach taken for the Scottish Marine Renewables SEA is consistent with the requirements of the SEA Act 2005.

The main requirements of the SEA Directive and the SEA Act 2005 include: the preparation of an environmental report; consultation; taking the results of the environmental report and consultations into account in decision-making; providing information on the decision making; and monitoring. The guidance breaks the requirements of the SEA Directive down into a series of 'Stages' (Stages A to E). Each of these stages will inform and interact with the preparation and development of Scottish Executive's strategy for marine energy and planning guidance for marine energy developers.

Stages A to E of the SEA process include:

- Stage A – Setting the context and objectives, establishing the baseline and deciding the scope
- Stage B – Developing and refining strategic alternatives and assessing effects
- Stage C – Preparing the Environmental Report
- Stage D – Consulting on the Environmental Report
- Stage E – Monitoring implementation of the marine energy strategy

Table A1.1 below summarises the main requirements of each of the five stages of the SEA process as presented in the ODPM Guidance in relation to the present study.

Due to the nature of the Scottish Marine Renewables SEA study it was deemed appropriate to modify some aspects of the overall approach. These modifications, whilst not adhering fully to the recommended approach set out in the ODPM SEA guidance and the Scottish SEA Toolkit, are in line with the requirements of the SEA Directive and its overarching objectives. The main modification relates to the development SEA objectives.

It was agreed from the outset of this project that, due to the complexity and nature of the marine environment, it was unnecessary to develop SEA objectives to assess the effects of the marine devices. Alternatively, the process was simplified by assessing the effects of the marine devices on each individual marine environment 'topics'. The 'topics' that were assessed were agreed through the formal scoping process. A summary of the scoping exercise is presented in Section A3.

Table A1.1 Requirements of the SEA Directive

SEA Stages
Stage A: Setting the Context, Establishing the Baseline and Deciding the Scope: Proposal of SEA objectives (not covered in this SEA) Proposal of SEA indicators and collection of baseline data Identify key environmental issues Identify relevant plans, programmes and environmental protection objectives Test objectives of the strategy for marine renewable energy against the SEA objectives Consult with authorities with environmental responsibilities on scope of SEA
Stage B: Developing Strategic Alternatives and Assessing Effects: Identify and refine strategic alternatives Predict the effects of installing the marine renewable energy devices on the environment Use significance criteria to evaluate the effects of installing the marine renewable energy devices on the environment Outline potential measures to mitigate against any adverse effects Propose measures to monitor the environmental effects of installing marine renewable energy devices on the environment
Stage C: Preparing the Environmental Report Prepare the Draft Environmental Report on the findings of the SEA and make recommendations to enhance the potential for development of marine renewable energy in Scotland
Stage D: Consulting and Decision Making: Consult with the public, community groups, authorities with environmental responsibilities (e.g. SEPA, Historic Scotland and Scottish Natural Heritage), other key stakeholders, industry/technology experts and academics Incorporate comments received from consultation and findings of the Environmental Report into development of the renewable strategy for marine energy and guidance for marine energy developers Assess significant changes to the strategy and guidance and produce the Final Environmental Report Issue a 'statement' of how the findings of the SEA were incorporated into the strategy and guidance
Stage E: Monitoring Implementation of the Plan: Develop aims and methods for monitoring Respond to adverse effects

A1.8 Study Limitations

The scope of this SEA was defined by the Scottish Executive's study terms of reference, the tender submission, the requirements of the SEA Directive, and good practice. Specific items of general concern or interest to a wider group of stakeholders may not be within the remit of this SEA. The specific items are given in Table A1.2, and the following text:

Table A1.2 Limitation of the Scottish Marine Renewables SEA

	Inside of Study Scope	Outside of Study Scope
1	Potential environmental effects will be identified and assessed at a strategic level.	Effects will not be assessed at a project specific level.
2	The SEA will provide baseline information pertinent to the strategic issues associated with the potential development of marine renewables.	The SEA will not replace the need for developers to collect detailed project specific baseline data.
3	The SEA will inform the development and implementation of the strategy for marine renewable energy.	The SEA will not specifically address issues of grid development policy, socio-economic development, or policy relating to consent procedures.
4	The SEA will help identify areas where there may be opportunities for, or environmental constraints against, development.	The SEA will not examine the commercial viability of development or provide cost/benefit analysis.

A1.8.1 Study Limitations

In addition to the issue affecting the scope of the SEA, key study limitations are as follows:

- There are **gaps in our knowledge of the marine environment**. The study area is extensive and there is limited information available for certain topics and locations. For example, the location and populations of species at sea (such as seals, birds and fish) is generally poorly understood. Additionally, there were limitations on the data available for some topics including commercial fisheries and shipping (particularly small vessels).
- There are **many types of marine renewable energy device, ranging in development stage from concept, through prototype/demonstrator to pre-commercial**. For this reason the study has identified characteristics which are common to different device types. It has also made assumptions on what comprises an 'array' of a number of devices (see Wave and Tidal Power section below).
- Over the study period (to 2020) marine renewable energy devices will be improved and **new technologies** developed. This may influence, for example, where they are located, how they are constructed and their size – all matters which have a bearing on their potential environmental effects.
- **Our knowledge of the effects of devices** on the environment is not well understood for some topics, such as the likelihood of collisions between fish, birds and mammals with the rotating blades underwater.
- Given the above limitations, there are further uncertainties over the **cumulative effects** of two or more device arrays in any given area.
- Actual **locations of wave and tidal power arrays** have not been determined. The SEA, whilst focussing on the areas identified as being of interest for development (as shown on Figure A), covers a broader region. With future technological improvements it may be possible to locate devices in areas currently not considered suitable and it is therefore not possible to dismiss any part of the study area because of resource constraints.
- Scotland has **limited electricity grid capacity,** i.e. the power lines in the north and west of Scotland are not sufficient to carry more electricity without being upgraded. Furthermore, Shetland is not connected to the national grid. These issues have important implications for the viability of wave and tidal power, and will also influence where devices can be located.
- The SEA has considered the generic environmental effects associated with **onshore grid connections** but has not assessed the environmental effects associated with grid.

A2 Project Description

A2.1 Project Overview

The main purpose of this Marine Renewables SEA is to strategically assess the potential environmental effects of developing wave and tidal devices off the west and north coasts of Scotland. The basis for this SEA is the Scottish Executive's policy for marine renewable energy which will guide the development of the Scottish Executive's strategy for marine energy.

The MEG report ("Harnessing Scotland's Marine Energy Potential") predicted that, by 2020, 10% of Scotland's renewable energy generation could come from marine sources. It also identified that there is potential for 1,300MW of marine renewable energy capacity to be installed in Scottish waters. As part of its commitment to developing a wide range of renewable energy technologies in Scotland in pursuit of its 40% target, the Scottish Executive is pursuing a range of measures designed to accelerate the development of wave and tidal energy.

These measures, taken together, will form the basis of a strategy for developing the marine renewable energy sector in Scotland, guided by the vision for the sector established in the MEG report.

It is arguable, since there is no *formal* strategy for the sector currently in place, that there is no 'plan or programme' as such upon which to perform the SEA. However, the policy and associated measures upon which the Executive's developing strategy for supporting marine renewables will be based are clearly established. These will therefore form the basis of the SEA. To ensure that the SEA provides the information that is needed to inform the development of the Executive's marine energy strategy, the assessment process has been developed to assess the potential effects that the exploitation of the estimated 1,300MW of marine energy capacity would have on the environment.

It has been identified that, in the absence of a specific plan or programme, there is a risk that the SEA may not be able to determine what the environment effects of a plan or programme would be, and whether they would be significant or not.

However, by developing a SEA process that assesses the policy that would form the basis of a strategy, rather than assessing the strategy, the Scottish Executive is able to (as far as is possible with current understanding and information) take account of all potential environmental effects associated with the exploitation of the marine renewable resource from the outset. This will help ensure that the proposals and policies underpinning its support for marine renewables are environmentally focussed, and that potential measures to avoid, reduce or offset any significant adverse environmental effects created or presented by marine renewable technologies are integrated where possible. The SEA will also provide information that will allow the Scottish Executive to identify potential conflicts between the emerging strategy for supporting marine renewables and other national strategies or policies (e.g. transport or defence).

A2.2 The Marine Renewable Energy Devices

The SEA will take account of the following categories of wave and tidal technologies:

- Shoreline wave;
- Nearshore and offshore wave; and
- Tidal stream.

Offshore wind and tidal barrage has been excluded from this SEA.

Renewable energy device information used in this SEA is that available in the public domain as at 2006.

A2.2.1 Offshore Wind

Wind has been excluded from this assessment for a number of reasons, both technical and geographical.

Technically and commercially, the offshore wind industry is far more advanced than either the wave or tidal industry. The FREDS (Forum for Renewable Energy Development in Scotland) report was commissioned to identify how to redress this balance by identifying opportunities for accelerating the development of the wave and tidal industry. It identified the importance of the SEA for providing valuable information to input into the development of appropriate guidance for wave and tidal developers.

Wave and tidal technologies are relatively embryonic when compared to offshore wind. For this reason it was felt that the inclusion of offshore wind within the SEA would lead to a dominance of this technology. This may lead to a dilution of the resources inputted into identification of effects associated with tidal and wave devices due to differences in information availability.

The technologies are also very different. Wave and tidal devices exploit energy produced by the marine environment (sea), whereas offshore wind devices exploit energy from the wind and are only linked to the marine environment through their location.

Offshore wind has also been excluded from this SEA on geographical grounds. The FREDS report identified that most of the interest for the development of wave and tidal devices was focused on the western seaboard of Scotland, the Pentland Firth and the Northern Isles (Orkney and Shetland). There was no evidence that developers would be interested in the east coast. There was also, at the time that the research was undertaken, very limited interest in the development of offshore wind on either the west or east coast of Scotland.

As the one of the main aims of the SEA is to provide guidance to accelerate the development of wave and tidal devices, it was considered to be an inefficient use of resources to include the east coast of Scotland in the study area when there is no or very little interest in developing these devices in this location.

However, the Scottish Executive has stated that, should the position on the east coast change with regard to wave and tidal development, then consideration will be given to commissioning a complementary east coast Marine Renewables SEA for wave and tidal devices. This approach of undertaking additional SEAs will also be adopted if interest for the development of offshore wind devices on either the west or east coast increases. In the meantime, the limited interest in offshore wind off the east coast can be dealt with via the current consenting and EIA process.

Excluding offshore wind will also free up resources to provide a better wave and tidal energy SEA. Furthermore, this thinking is in line with recent decisions taken by the Executive. For example, the Scottish Executive's consultation on proposals to introduce a Scottish Marine Supply Obligation (MSO) under the current ROS, which will target support more directly at wave and tidal technologies.

A2.2.2 Tidal Barrage

Tidal barrage projects will not be included for commercial and environmental reasons. Commercially, there has been very little interest in the development of tidal barrages in the SEA study area (Scottish Natural Heritage, April 2004). This is due, in part, to the environmental concerns associated with a potential reduction in the extent of intertidal zones and the knock-on effects on waterfowl and in consequence the perceived difficulties in obtaining consent for such projects.

A2.3 The Study Area

As discussed above, the areas identified by MEG as being of greatest interest to wave and tidal developers included:

- Western Seaboard of Scotland (including the Solway Firth, Argyll and Bute, Inner Isles, Western Isles and Outer Isles)
- Pentland Firth and North Coast
- Northern Isles (Orkney and Shetland).

These areas are illustrated in **Figure A**: Study Area.

A2.3.1 Seaward Extent of Study Area

The seaward extent of the study area is the 12nm limit of territorial waters. This is not to suggest that there is no interest in developing wave and tidal devices beyond 12nm but to ensure that the SEA is focused on the areas that have been identified as currently having the greatest interest for wave and tidal developers.

Developers confirmed, at a developers' workshop run jointly by EMEC (European Marine Energy Centre) and the SEA team in October 2005, that the current area of interest for the development of wave and tidal devices is within the 12nm limit. The purpose of the developers' workshop was to obtain technical information about the different wave and tidal devices that are currently under development. The information collected during the workshop has been used in Section B: Marine Renewables: Technology and Resource of this report to develop an understanding of the characteristics of the marine devices that would be assessed as part of the SEA and to identify generic environmental effects that the devices may have on the marine environment.

The developers confirmed during the workshop that, whilst there may be potential interest to develop marine renewables beyond the 12nm limit, initial efforts would generally be focused on exploiting resources within the 12nm limit. This is primarily driven by the fact that the resources are closer to land. Amongst other things, the distance of a development from land affects the costs associated with connecting a device into the electricity grid system and the feasibility and efficiency of the maintenance of the devices.

A2.4 Commercial Sites Versus Test Sites

As mentioned previously, the majority of wave and tidal devices are still in the early stages of development. The implication of this is that a large proportion of the developments that will occur in the near future may be test or demonstration, rather than commercial developments.

The aim of the SEA is to assess the effect on the environment from marine renewables contribution towards meeting the Scottish Executive's renewable energy targets. Electricity generated by test and demonstration developments do not often contribute significant amounts of power to the Scottish Grid. Additionally test or demonstration installations are just that and are not economically viable on a long term power generation basis. Therefore these types of development are not considered to be commercial. Moreover, there has already been significant public sector investment in creating a test and demonstration site for wave and tidal technologies in Orkney, and the expectation is that most testing of marine energy devices in Scotland will take place here. In terms of helping to meet the Scottish Executive's renewables target, the focus will be on the development of commercial sites. As a result, whilst it is recognised that there may be a small initial demand for additional sites that can be used for testing or demonstration projects, the SEA will only focus on commercial sites, where an array will contribute electricity to the Scottish grid.

It is understood, through consultation with The Crown Estate, that the SEA will not affect the consenting arrangements for the licensing and leasing of test and demonstration sites that are administered by The Crown Estate. In keeping with legislative requirements set out in the Works (Environmental Impact Assessment) (Scotland) Regulations 2000, the effects of test and demonstration projects on the environment will be assessed through the EIA process.

It should also be noted that this SEA is not being carried out for the licensing of potential sites, as with the England and Wales offshore wind licensing round 2. The results of this SEA will be used to inform the development of the Scottish Executive's strategy for marine energy and are totally unrelated to the licensing of commercial wave and tidal sites. The identification of potential sites does not imply the ready consent of applications to deploy devices; any such applications would be considered on their merits.

A2.5 The Scottish Electricity Distribution Network

The MEG report identified the capacity of the Scottish electricity grid as a significant constraint to the future development of marine renewables. In fact, the current transmission capacity of the electricity grid in Scotland acts as a significant constraint upon the development of all forms of renewables. In the absence of investment in and building of new capacity, the development of marine renewables may not progress significantly beyond the demonstration stage.

Although grid capacity and connections are reserved, the Scottish Executive is fully involved in discussions between stakeholders from the renewables sector and other relevant players, such as the grid owners and operators, industry regulator Ofgem, and the Department for Trade and Industry (DTI).

In addition to the transmission capacity of the Scottish grid, the SEA has taken into consideration the potential environmental effects associated with connecting marine devices into the network. There is potential for grid connections to affect the marine environment (marine cables) and the terrestrial environment (cabling, overhead lines and substations). In line with the requirements of the SEA, this assessment of the effects of grid connections on the marine and terrestrial environment will be performed at a strategic level only; it is not within the scope of this SEA to provide detailed coverage of upgrades to the Scottish grid.

A3 Scoping Summary

A3.1 Introduction

This chapter provides a summary of the main comments that were received during the scoping stage of the SEA. It also identifies the SEA topics for which no further assessment would be required on the basis of the information presented in the Scoping Report. These 'scoped out' SEA topics are listed in Table A3.1. The Scoping Report is available for download from the above website address.

A3.2 Scoping Responses

The key points raised during consultation on the scope of the SEA are summarised in sections A3.2.1 to A3.2.4 below. Where appropriate, the comments listed below have been addressed within this Environmental Report.

A3.2.1 Comments Received on Scoping Report Chapters 1 to 4: Introduction, Project Description, SEA Framework and Policy Review

- It should be clearly stated in the report introduction that the SEA is only focused on wave and tidal devices and does not include the east coast of Scotland
- The report should refer to the most recent Scottish Climate Change Programme 'Changing our Ways' which was published in March 2006. Reference should also be made to NPPG 6: Renewable Energy Developments which is currently being reviewed and subject to an SEA
- Plans, programmes and legislation relating to the marine and coastal historic environment, also need to be included in the SEA.

A3.2.2 Comments Received on Scoping Report Chapters 5 to 7: Description of Marine Devices, Marine Resource Areas and SEA Topics

- Recommended additional information to be considered in the site selection criteria (Scoping Report Chapter 6) includes:
  - Marine Consultation Areas
  - Recorded and unrecorded wrecks
  - Submerged landscapes
- Recommend that the SEA Topic: Marine and Coastal Archaeology and Wrecks is renamed as Marine and Coastal Historic Environment as this has a broader meaning.

A3.2.3 *Comments Received on Scoping Report Chapters 8 to 11: Baseline Data and Predicted Effects, Summary of Potential Impacts, Data Gaps, Recommendations for Further Work*

- Key additional points to consider in terms of baseline data include:

  - Effect of antifouling paints and other contaminants on habitats and species
  - Provide an explanation of what Marine Consultation Areas are
  - Ensure all SACs and SPAs that overlap with potential wave and tidal resource areas are illustrated on the relevant map (Figure 11 of Scoping Report)
  - Where appropriate illustrate seabird feeding and foraging areas on maps
  - Additional data source 'Seabirds at sea in summer in Northwest North Sea' – Camphuysen's paper in British Birds (January 2005)
  - Baseline description for the historic environment should include Abey and Dead wrecks as well as live wrecks. It should also include World Heritage Sites

- Baseline data gaps and inaccuracies:

  - Data on the at-sea distribution of seabird colonies is considered to be poor
  - The ESAS database is not considered to be adequate for the purpose of the SEA due to data being patchy and having a low resolution in time and space
  - Gaps in data on the status of cetaceans and the abundance and movement of other marine mammals
  - Approximately 75% of RCAHMS maritime records (and therefore Pastmap records) refer to historic casualties at sea, often with inaccurate or approximate positioning. This reduced the accuracy of the data

- Additional surveys:

  - It is acknowledged that the SEA will not involve any additional detailed survey work to be undertaken
  - RSPB and CEH are developing a foraging model for seabirds that could inform the SEA
  - RSPB suggest that a collision risk method is developed to investigate the effects of wave and tidal devices on marine mammals and birds as a result of collision risk
  - The Sea Mammal Research Unit is monitoring marine mammals at two locations where tidal turbine devices are to be deployed. The results and method could be used at other potential tidal turbine sites
  - It is important for the SEA to identify data gaps and prioritise and focus future survey work
  - There is also a need for the SEA to identify areas for future investigations and research (monitoring programmes) to improve the understanding of the effects that devices have on different receptors

A3.2.4 *Comments Received on Scoping Report Chapter 12: Assessment Method*

- It is important for effect significance to take into consideration both receptor value and vulnerability

- It may be difficult to determine the likelihood of occurrence for all effects where there are data gaps and/or gaps in the understanding of the effects that may occur

- The precautionary principle approach should be adopted under the following scenarios:
  - Where environmental resources effected are of high importance (e.g. nationally or internationally protected)
  - Where there is potential for adverse effects but these are subject to uncertainty e.g. due to data gaps, likelihood of occurrence, lack of understanding about interactions
  - A lack of data or evidence of an effect should not be considered as a reason for a scheme to proceed as planned and the precautionary principle should be applied
  - Explore opportunities for adaptive regimes where developments are allowed to proceed on a monitored basis with an undertaking to modify the development in prescribed ways if the effects in practice are shown to be likely to exceed prescribed thresholds

A3.3 Scope of the Environmental Report

Table A3.1 provides a summary of the SEA topics that are covered in the Environmental Report (strategically assessed to identify significant environmental effects), and those that have been 'scoped out' of the SEA and reasons for their removal.

Table A3.1 Scoping of SEA Topics

Marine SEA Topics	Covered in SEA?	Reason SEA Topic scoped out
Marine physical environment		
Bathymetry	X	As identified in the Scoping Report It is expected that the development of wave and tidal devices will not have any significant effects on seabed bathymetry. However baseline information relating to bathymetry will be used to inform the assessment of effects on other SEA topics e.g. metocean/marine processes/shipping
Geology and sediment transport	✓	
Marine processes and hydrography	✓	
Sediment contamination and water quality	✓	
Marine biological environment		
Protected sites and species	✓	
Benthic and intertidal ecology	✓	
Fish and shellfish	✓	
Birds	✓	
Marine mammals	✓	
Human environment		
Commercial fisheries, shell fisheries and aquaculture	✓	
Marine and coastal historic environment	✓	
Oil and Gas infrastructure	X	As identified in the Scoping Report there is almost no oil and gas development or development potential within the study area. Therefore there are no predicted effects
Cables and pipelines	✓	
Military exercise areas	✓	
Disposal areas	✓	
Aggregate extraction	X	Review of baseline data in the Scoping Report identified that there are no existing or proposed aggregate extraction areas within the study area. Therefore there are no predicted effects
Shipping and navigation	✓	
Recreation and tourism	✓	
Other topics		
Noise	✓	
Air quality	X	There are no significant atmospheric emissions associated with wave and tidal devices, therefore no predicted effects
Electric and magnetic fields	✓	
Landscape, seascape and visual receptors	✓	
Onshore Grid Connection	✓	
Decommissioning	✓	

A4 Assessment Method

A4.1 Introduction

This section sets out the method that has been developed to assess the likely effects that meeting or exceeding the estimated 1,300MW of marine renewable energy capacity would have on the environment.

The assessment method has been split into 2 levels:

- Level 1: Assessment of effects of tidal and wave devices on the marine environment through the application of the main assessment method described in sub-section A4.2
- Level 2: Energy Resource Assessment and Cumulative Effects.

The approach aims to achieve the following:

- Strategically assess the effects of wave and tidal technologies on different aspects of the marine environment and on a topic-by-topic basis set out mitigation measures for reducing potential effects.
- Based on the available information, identify how much of the wave and tidal energy resource in the SEA study area could be exploited taking environmental effects into account
- Assess the potential cumulative environmental effects of wave and tidal devices
- Recommend measures to mitigate the potential cumulative effects of the wave or tidal devices on the marine environment.

It should be noted that this SEA does not address detailed issues associated with a site-specific development. It also does not replace the need for targeted surveys and studies required to assess the environmental effects of a specific development.

A4.1.1 Review of Similar Methodologies

The assessment method has been informed by a review of similar 'strategic' studies, including:

- DTI Offshore Energy Licensing SEAs (http://www.offshore-sea.org.uk/site)
- Offshore Wind Energy Generation: Phase 1 Proposals and Environmental Report (BMT Cordah Ltd for the DTI, 2003)
- Countryside Council for Wales (CCW, 2005) Study "Potential Nature Conservation and Landscape Impacts of Marine Renewable Energy Developments in Welsh Territorial Waters".

Other studies and information sources are referenced throughout the report.

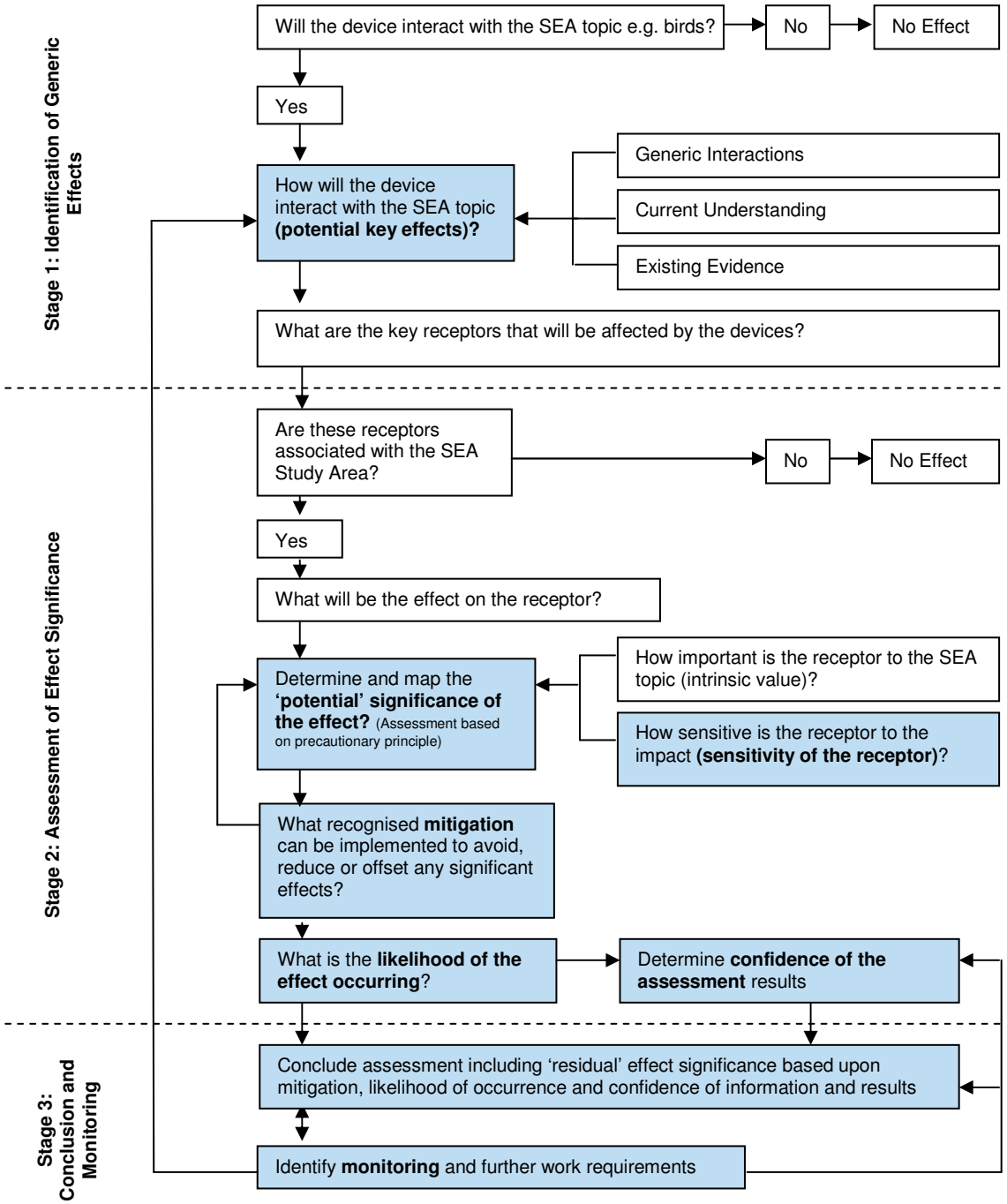
A4.1.2 Development of the Assessment Method

The proposed method for assessing the effects of the marine devices involves a number of different stages. The aim has been to follow a logical and clear process to enable the results of the assessment to be easily traced. It should also be noted that the method allows for minor modifications and refinements to be made according to the topics being assessed and to take account of the availability of information.

A4.2 Level 1 Assessment – Assessment Method

The purpose of the flow diagram below (Figure A4.1) is to illustrate the 'thought' process that the assessors have followed when carrying out the assessment, as illustrated through the use of questions at certain stages in the process. In some situations there may be a need for different parts of the assessment to be revisited where, for example, new information is provided. Each of the stages interacts with, and informs, other stages.

Figure A4. 1: SEA Assessment Method Flow Diagram



As illustrated in Figure A4.1 above, the method used in the Level 1 Assessment has been split into 3 main stages:

Stage 1: Identification of generic effects

Stage 2: Assessment of effect significance

Stage 3: Conclusions, surveying and monitoring

A4.2.1 Stage 1: Identification of Generic Effects

The aim of this part of the assessment is to understand how a device interacts with a specific aspect of the marine environment (SEA topic, for example marine mammals). This part of the assessment is non-geographical. The information obtained at this stage could be applied to any marine environment (e.g. not just Scotland).

To be able to understand how a device interacts with a specific SEA topic the following factors were identified:

- Device characteristics
- Review of existing evidence and research into potential impacts associated with wave and tidal devices

A4.2.1.1 Device Characteristics

The different device characteristics are discussed in detail in Chapter B1 of the Environmental Report, Marine Renewables – Technology and Resource: Device Characteristics.

The study has identified that there is a number of different device characteristics. The range of variables identified includes, for example, position in the water column, method of attachment to the seabed, optimal water depth and device type (e.g. oscillating water column or hinged floating device). In addition to the device 'design' characteristics, the assessment also took into account requirements for installation, operation, maintenance and decommissioning of a device.

Each of the device characteristics identified in Chapter B1 have a range of likely environmental interactions depending upon the aspect of the marine environment that is being assessed. This is explained in more detail in sub-section A4.2.1.3: Summary of Key Effects.

A4.2.1.2 Existing Evidence and Research

The identification of generic interactions was informed by current understanding and a review of existing evidence. This information was obtained through close consultation with field experts and reviews of available documented research. Details of the information obtained from these reviews of existing evidence and current understanding are presented in the assessment chapters, Chapters C1 to C21 of Section C of the Environmental Report: Results of the Level 1 Assessment.

A4.2.1.3 Summary of Key Effects

Where possible, the key potential effects identified for each SEA topic being assessed are summarised in a table. For example, in terms of the assessment of the effects of the marine devices on fish and shellfish, the following summary table (Table A4.1) was produced:

Table A4. 1: Example of Summary of Effects on Fish and Shellfish

Potential Key Effects	Development Phase	Direct/Indirect	Duration	Extent
Disturbance	CC CD	Direct	Temporary (during installation)	Cable and device installation area
Smothering	CC CD	Direct	Temporary (during installation)	50 m
Increased turbidity	CC CD	Indirect	Temporary (during installation)	Negligible
Increased suspended sediment	CC CD	Indirect	Temporary (during installation)	Negligible
Collision risk	OD	Direct	Long term (device life)	Study area
Substratum loss	OD	Direct	Long term (device life)	Within device array area
Decrease in wave exposure	OD	Direct	Long term (device life)	500 m
Decrease in water flow	OD	Direct	Long term (device life)	20 km
Changes in turbidity	OD	Indirect	Long term (device life)	Negligible
Changes in suspended sediment	OD	Indirect	Long term (device life)	Negligible
Disturbance of contaminated sediments	CC CD	Indirect	Temporary (during installation)	Negligible
Contamination from anti- fouling paints and sacrificial anodes	OD	Direct	Long term (device life)	Negligible
Accidental contamination (hydraulic fluids)	OD	Direct	Long term (device life)	Impossible to quantify
Electric and Magnetic Field	OC	Direct	Long term (cable life)	Negligible
Marine Noise	CD CC OD	Direct	Long term (device life)	Up to tens of km
Fishing exclusion areas (positive impact)	OD	Indirect	Long term (device life)	Impossible to quantify

CD = Construction/decommissioning impact – devices
CC = Construction/decommissioning impact - cables
OD = Operation impact – devices
OC = Operation impact – cables

A4.2.2 Stage 2: Assessment of Effect Significance

A4.2.2.1 Key Issues Considered in the Assessment of Effect Significance

This part of the assessment looks at the relationship between the generic effects identified in Stage 1 and the marine environment associated with the SEA study area. The key issues that were considered in Stage 2 of the assessment included:

- Potential effects on SEA topics (and key receptors associated with those topics) associated with the study area. This assessment was based on an understanding of the generic effects that the devices could have on the SEA topics
- Identifying the distribution of different receptors throughout the study area
- Understanding the characteristics of different receptors in different locations and how they relate to/interact with the marine environment in which they are located.
- Identification of whether a receptor is 'sensitive'/'vulnerable' to the identified generic effects
- Assessment of the significance of the effects (generic effects + levels of sensitivity)
- Identification of distinctions between negligible effects and un-measurable effects
- Identification of 'recognised' mitigation measures that can be implemented to reduce, avoid or offset any potentially significant adverse effects
- Assessment of the likelihood of an effect occurring

A4.2.2.2 Sensitivity of the Receptor

Sensitivity is the measure of how vulnerable a receptor is to the potential key effects identified previously. The resulting 'sensitivity of the receptor' is then used to evaluate the significance of the effects of the wave and tidal devices. For some of the SEA topics specific criteria for measuring receptor sensitivity was sourced from reputable data/information sources e.g. ww.marlin.ac.uk. For topics where there was no previously established sensitivity criteria available, current understanding and existing evidence was used to development appropriate sensitivity criteria. These criteria are presented in the relevant assessment chapters (Chapter C1 to C21 of Section C of the Environmental Report: Results of the Level 1 Assessment).

It should be noted that it may not always be possible to accurately determine the sensitivity of a specific receptor. This may be due to a lack of baseline data or due to limited understanding of how a device will interact with a receptor and therefore how vulnerable that receptor would be to the predicted effect. An example of the criteria used to measure the sensitivity of fish and shellfish to different key effects is presented in Table A4.2 below.

Table A4. 2: Example of the Sensitivity of Fish and Shellfish to Different Potential Effect from Marine Device

Species	Potential Key Effect				
	Smothering	**Changes in suspended sediment**	**Increased turbidity**	**Collision risk**	**Substratum loss**
Spurdog (*Squalus acanthias*)	Not sensitive	Not relevant	Unknown	Unknown	Not relevant
Lesser spotted dogfish (*Scyliorhinus canicula*)	Low	Not relevant	Unknown	Unknown	Not relevant
Basking shark (*Cetorhinus maximus*)	Not sensitive	Low (filter feeder)	Unknown	Unknown	Not relevant
Porbeagle (*Lamna nasus*)	Not sensitive	Not relevant	Unknown	Unknown	Not relevant
Tope(*Galeorhinus galeus*)	Not sensitive	Not relevant	Unknown	Unknown	Not relevant
Thornback *ray (Raja clavata*)	Low	Not relevant	Unknown	Unknown	Not relevant
Common skate *(Dipturus batis*)	Low	Not relevant	Not sensitive	Unknown	Low
Herring (*Clupea harengus*)	High (demersal eggs)	medium (filter feeder)	Unknown	Unknown	High (spawning areas)
Sprat (*Sprattus Sprattus*)	Not sensitive	medium (filter feeder	Unknown	Unknown	Not relevant

A4.2.2.3 Effect Significance

The measure of the significance of the effect that the installation, operation and decommissioning of the marine devices will have on the environment is the key part to this SEA assessment. Specific effects associated with the maintenance of devices have not been considered in any detail as this is not considered to be a key impact on a strategic level. The measure of significance is essential to the decision-making process as it enables the most critical issues to be identified.

Significance measures the likely extent of the effect in relation to the sensitivity of the receptor and the intrinsic value of the receptor. Where possible, the measure of significance has been quantified. Where measures of significance could not be quantified, subjective professional judgements have been made.

Significance analyses the relationship between the predicted effect, the intrinsic value of the receptor, e.g. subject to any statutory designation, and the sensitivity of the receptor to that effect. To assist with the assessment of effect significance and to improve the robustness and transparency of the results, topic-specific assessment criteria were developed for each of the topics addressed in this SEA. Details of the assessment criteria are provided in Chapters C1 to C21 of Section C of the Environmental Report: Results of the Level 1 Assessment.

The following is an example of the significance criteria used in the assessment of effects of marine devices on fish and shellfish:

Table A4. 3: Example of Significance Criteria (Fish and Shellfish)

Significance level	Determining criteria
High	Effect on a known area of ecological importance designated for its fish or shellfish species under Annex II of the habits directive, or a UKBAP priority species where a fish or shellfish species that has a high - very high sensitivity to the impact in question is within the zone of influence of that impact.
Moderate	Effect on a known area of ecological importance designated for it's fish or shellfish species under Annex II of the habits directive, or a UKBAP priority species, where a fish or shellfish species that has a low to moderate sensitivity to the effect in question is within the zone of influence of that effect; or Effect on a known area inhabited by a fish or shellfish species that is nationally rare of scarce, and has a high – very high sensitivity to the effect in question and is within the zone of influence of that effect; or Effect on an area not designated under national or international legislation for it's fish or shellfish populations, where a fish or shellfish species that has a high to very high sensitivity to the effect in question is within the zone of influence of that effect;
Minor	Effect on an area not designated under national or international legislation for it's fish or shellfish populations, where a fish or shellfish species is nationally common or widespread, and that has a low to high sensitivity to the effect in question is within the zone of influence of that effect; or Effect on a known spawning or nursery area where a fish or shellfish species that has a moderate - low sensitivity to the effect in question is within the zone of influence of that effect.
Negligible / no impact	No species/habitats that are sensitive to the effect in question are within the zone of influence of that effect.

A4.2.2.4 Measuring Effect Significance

The assessment of effect significance was undertaken at two levels:

- Potential effect significance – this is a measure of the likely significance of a predicted effect WITHOUT mitigation
- Residual effect significance – this is a measure of the likely significance of a predicted effect WITH mitigation

A4.2.2.5 Presentation of the Results from the Assessment of Effect Significance

The discussion and presentation of results from the assessment of effect significance is complex due to the strategic nature of this assessment, i.e. the large geographic area; the wide range of device types and array formats; and the levels of uncertainty surrounding the prediction of the effect that a device or array will have on a certain receptor.

The main objectives of this SEA are to guide the development of the Scottish Executive's strategy for the development of marine energy and to inform the project-level decision-making process for all stakeholders. The presentation of results has been designed to facilitate this.

To improve the clarity and transparency of the assessment, the results of effect significance are presented in the following formats:

- Tabulations:
  - Tables summarising potential effect significance
  - Tables summarising residual effect significance
- Significance maps

In addition to the tables and maps, explanations of the results obtained and the supporting evidence has been provided as written text.

Potential Effect Significance

The results from the assessment of potential effect significance in each chapter have been presented in a table comprising the following same or similar (where appropriate) format:

Table A4. 4: Example of Predicted Effects of Devices and the Potential Effect Significance

Potential effects	Device characteristic	Development phase	Receptor	Likely impact extent	Potential effect significance	Mapping
Disturbance	All devices	CC CD	All mobile species	Cable and device installation area	Minor	Not mapped
Smothering	Piled devices and cables	CC CD	Demersal species shellfish demersal spawning areas (herring and sandeel)	50m	Minor - moderate	C7.5
Increased turbidity	All wave and tidal devices	CC CD	Filter feeders	Negligible	Minor	Not mapped
Collision risk	Offshore wave and all tidal	OD	All mobile species	Unknown	Unknown	Not mapped
Substratum loss	All devices attached to the seabed	OD	Shellfish; benthic spawners (herring and sandeel)	Within array area Wave:0.24-2km^2 Tidal: 0.36-4km^2	Minor – moderate	C7.8
Increased suspended sediment	All wave and tidal devices	OD	Filter feeders	Negligible	Minor	Not mapped
Decrease in water flow	All tidal	OD	Shellfish	500m	Minor	C7.7
Decrease in wave exposure	All wave	OD	Shellfish juvenile plaice, cod and saithe	20km	Minor	C7.6
Contamination from anti-fouling paints and sacrificial anodes	Wave and tidal devices	OD	All fish and shellfish species	Negligible	Minor	Not mapped

CD = Construction/decommissioning impact – devices
CC = Construction/decommissioning impact - cables
OD = Operation impact – devices
OC = Operation impact – cables

Residual Effect Significance

Table A4.5 below illustrates how the results of the assessment of residual effect significance have been presented in each of the assessment chapters. The assessment of residual effect significance takes into account the following:

- Mitigation measures
- Likelihood of occurrence
- Confidence and knowledge gaps

Table A4. 5: Example of Residual Effect Significance

Potential Effects	Device Characteristics	Development Phase	Receptor	Potential Effect Significance (WITHOUT MITIGATION)	Industry Good Practice Mitigation	Likelihood of Occurrence	Residual significance (WITH MITIGATION)	Confidence Level
Disturbance	All devices	CD CC	All mobile species Breeding Aggregations	Minor Moderate	Avoid sensitive sites / species / breeding periods	High	Minor	High
Smothering	Piled devices and cables	CC CD	Demersal species Shellfish Demersal spawning areas (herring and sandeel)	Moderate Major	Avoid sensitive sites / species / breeding periods	High	Minor	High
Increased suspended sediment and turbidity (installation)	All wave and tidal	CC CD	Filter feeders	Minor	None	Low	Minor	Low
Marine noise (installation)	Piled devices	CC CD OD	Marine finfish (particularly cod and herring)	Unknown	Avoid installation during sensitive periods	Unknown	Unknown	Low
Increased suspended sediment	All wave and tidal	OD	Filter feeders	Minor	None	Low	Minor	Low
Collision risk	Offshore wave and all tidal	OD	All mobile species	Unknown	Careful design Avoid sensitive areas Use of protective netting or grids	Unknown	Unknown	Very low
Substratum loss	All devices attached to the seabed	OD	Shellfish; benthic spawners (herring and sandeel)	Moderate to Major	Avoid sensitive sites	High	Minor	High
Decrease in wave exposure	All wave	OD	Shellfish juvenile plaice cod and saithe	Minor	None	High	Minor	Low
Decrease in water flow	All Tidal	OD	Shellfish	Minor	None	High	Minor	Low
Changes in turbidity	All wave and tidal	CC CD	Filter feeders	Minor	None	Low	Minor	Low
Changes in suspended sediment	All wave and tidal	OD	Filter feeders	Minor	None	Low	Minor	Low
Contamination from anti-fouling paints and sacrificial anodes	All wave and tidal	OD	All fish and shellfish species	Minor	Use of low toxicity compounds	Low	Minor	Low

CD = Construction/decommissioning impact – devices
CC = Construction/decommissioning impact - cables
OD = Operation impact – devices
OC = Operation impact – cables

Significance Mapping

Where appropriate and practical the results of the assessment of effect significance have been illustrated on significance maps. The maps have been used to illustrate the different levels of potential effect significance that wave or tidal devices could have on specific receptors. This improves the clarity and accessibility of the results. For manageability and consistency purposes these Level 1 Assessment maps are generally presented at a scale covering the entire study area.

It is important to note that the maps produced for the Level 1 Assessment illustrate the levels of significance of the potential effects WITHOUT mitigation. The text contained within the assessment chapters explains how the levels of significance would change following the implementation of standard practice mitigation measures (residual significance). Further details of the approach towards mitigation are presented below.

A4.2.2.6 Mitigation Measures

Three main types of mitigation have been identified that could be applied to the assessment of marine renewable devices. These are:

- Mitigation incorporated into the design of a device and siting of a development
- Mitigation based on the implementation of environmental protection measures that will be informed by targeted surveys/more detailed assessments of proposed development areas. (The need for this type of mitigation can be identified through the SEA process. However, the detail of these mitigation measures, and methods for their implementation, can only be developed at a project level, e.g. through the EIA process).
- Recognised mitigation measures (standard application to a range of developments)

As the precautionary approach is being followed for this SEA, the significance mapping shows “potential effect significance” which assumes that no mitigation is applied. In order to give what is considered to be a more realistic representation of effect significance, residual significance has also been assessed, based on potential significance, and taking into account good practice mitigation and likelihood of occurrence.

For the purpose of this SEA, good practice mitigation can be described as measures that are commonly applied to a range of different types of development or certain environmental receptors. Good practice mitigation measures include (for example):

- Seasonal restrictions on device installations (e.g. avoidance of breeding season for birds)
- Avoidance zones around developments, cables, pipelines, etc (access requirement for maintenance)

Good practice mitigation measures are generally recognised by developers and regulatory authorities and standard approaches to their application have in most instances been developed for a range of different types of development which take place in the marine and coastal environment.. It was therefore deemed appropriate that these measures could be used to inform the assessment of residual effect significance.

Given that the SEA has been undertaken at a relatively early stage in the development and deployment of marine renewable devices, it is not possible to know exactly what other measures would be incorporated into the design of a device or array to avoid, reduce or offset any potential effects. These other mitigation measures which may be implemented by designers or developers, and which cannot at this time be considered standard practice, have therefore not been used to inform the assessment of the residual effect significance.

It is appreciated that specific mitigation measures would be derived from targeted surveys or more detailed assessments that are carried out at future project consenting stages. Therefore following the precautionary approach the effects stated in this report, which do not take account of all possible mitigation measures, may be higher than those which occur in reality.

It is important to note that, although mitigation measures have been taken into account in the assessment of the environmental effects, there are no guarantees that these measures will be implemented at the project level. In recognising where mitigation could be used to reduce and prevent significant effects, it is therefore important to identify mechanisms as part of the Scottish Executive's strategy for the development of marine energy to regulate the appropriate implementation of those mitigation measures at the project level.

A4.2.2.7 Likelihood of Occurrence

The assessment method set out in the previous sub-sections identifies the effect that a marine device could have on a specific receptor and measures the potential significance of that effect. Likelihood of occurrence considers the 'probability' that the identified effect will actually occur. This assessment takes account of a range of factors including the distribution of a specific receptor across the study area and certain behavioural characteristics e.g. breeding or feeding habits. Likelihood of occurrence also takes account of the characteristics of the different devices and their operation. For example it includes the probability or likelihood that of a certain device will actually fail during operation, possibly leading to contamination, or the probability that a device will be located in a certain type of environment or certain location.

A4.2.2.8 Confidence and Knowledge Gaps

As mentioned previously, this SEA has been carried out at an early stage in the development of marine renewable devices. As a result of this there are areas where there is insufficient information available about the devices, and their operation, to determine exactly how they may affect a given SEA topic, or certain environmental receptor.

As well as the unknowns associated with the device technologies, the SEA has also had to take account of the 'gaps' in the baseline data, and limited understanding of receptor interaction with devices. Due to the extent of the marine environment, and its relative inaccessibility in comparison to the terrestrial environment, understanding of its characteristics, and their interactions, are limited. Most information on the marine environment has either been collected for areas where surveys have been undertaken in relation to specific developments or commissioned for key areas or topics of interest e.g. seal habitats. Information relating to the different 'uses' of the marine environment, e.g. navigation, is more detailed.

The assessment confidence part of the SEA has been designed to ensure that the assessment process fully identifies and acknowledges the gaps in the understanding of how devices interact with the marine environment and gaps in the baseline data. The assessment has also identified, where possible, gaps in the data and examines the potential for filling these gaps.

A4.2.3 Stage 3: Conclusion, Surveying and Monitoring

A4.2.3.1 Summary of Effects

The main conclusions from the Level 1 Assessments (Chapters C1 to C21) are presented in Section D of the Environmental Report (Chapter D2: Level 1 Assessments – Conclusions). The conclusions have been presented in the following way:

- Level 1 Environmental Effects – Conclusions from the Level 1 Assessment are discussed on a topic by topic basis
- Area Specific Environmental Effects – the conclusions from the Level 1 Assessment are presented in summary tables (Tables D2.4 to D2.11) relating to each of the potential future development areas. These development areas are
    - Northern Isles (Orkney and Shetland)
    - Pentland Firth
    - North Coast
    - Outer Isles
    - Western Isles
    - Inner Isles
    - Argyll and Bute
    - North Channel and Solway Firth

The information obtained from the Level 1 Assessments was then used to inform the energy resource assessment (Chapter D3) and the assessment of cumulative effects (Chapter D4).

A4.2.3.2 Recommendations for Surveying and Monitoring

Based on the assessment confidence, surveying and monitoring has been suggested to fill baseline data gaps and to improve the level of understanding on how marine devices interact with certain environmental receptors. This will help to improve future assessment confidence.

It is important to identify, at this stage, that this SEA is an evolving process. Even at the current time, surveys relating to the marine environment are being commissioned or undertaken. Whilst these surveys are separate to the SEA process, e.g. were commissioned prior to the SEA or are commissioned for other research purposes, once completed and if appropriate and available, they could potentially be fed back into the SEA process at a later stage to help improve the robustness and accuracy of the assessment.

This part of the assessment process also identifies areas where additional research studies or monitoring could be undertaken to increase our understanding of how the devices interact with the marine environment. Opportunities for surveying and monitoring are discussed in Section E of the Environmental Report. Where significant additional datasets are made available e.g. data on the at-sea distribution of seabird colonies, there may be opportunity for the SEA to be revisited in the future and a re-assessment of potential effects made.

A4.3 Level 2 Assessment – Energy Resource Assessment and Cumulative Effects

Details of the methods used to assess the wave and tidal energy resource and cumulative effects are provided in Section D of the Environmental Report (Chapters D3: Energy Resource Assessment and D4: Cumulative Effects).

Appendix A1.1: Steering Group

The SEA has been guided by a Steering Group, with representatives drawn from a broad range of stakeholders. These are listed below:

Steering Group:

Convention of Scottish Local Authorities (CoSLA)

The Crown Estate

European Marine Energy Centre (EMEC)

Fisheries Research Services (FRS)

Heriot-Watt University

Joint Nature Conservation Committee (JNCC)

Maritime and Coastguard Agency (MCA)

Ministry of Defence (MoD)

Royal Society for the Protection of Birds (RSPB)

Scottish Environment Protection Agency (SEPA)

Scottish Fishermen`s Federation (SFF)

Scottish Natural Heritage (SNH)

West Coast Energy (representing industry)

Historic Scotland