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Marine Scotland

Socio-Economic Impact Assessment of proposed Marine Protected Areas

Socio-Economic Impact Assessment

May 2019

Report prepared by:

For:

Non-Technical Summary

Introduction

The Marine (Scotland) Act 2010 and the UK Marine and Coastal Access Act 2009 contain provisions for the designation of a network of Marine Protected Areas (MPAs) in Scottish territorial and offshore waters in order to protect marine biodiversity and geodiversity and contribute to a UK and international network of MPAs. Marine Scotland consulted on 33 proposed MPAs in 2013, and 30 MPAs were designated in July 2014. Four additional search locations were still being assessed at the time of consultation and these are now ready for Ministerial consideration.

A formal public consultation on proposals for designation of the four new proposed MPAs (pMPAs) will be undertaken in 2019. Following this public consultation, Scottish Ministers will decide on whether to designate specific sites as MPAs.

Marine Scotland's policy is to provide information on the potential economic, social and environmental impacts of possible marine designations to Ministers before consultation. Evidence of the environmental and socio-economic impacts of designation of conservation sites in the marine environment is required to progress designation of MPAs under the Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009.

What is Socio-Economic Impact Assessment?

Socio-economic impact assessment (SEIA) aims to identify and assess the potential economic and social effects of a proposed development or policy on the lives and circumstances of people, their families and their communities. The assessment investigates the potential cumulative economic benefits and costs, and associated potential social impacts, of implementing the proposed management scenarios at each individual MPA. It also considers the potential economic benefits and costs, and associated potential social impacts of implementing the suite of measures overall.

The assessment provides Marine Scotland with evidence on economic and social effects to inform a Business and Regulatory Impact Assessment (BRIA) for each MPA, and a Sustainability Appraisal for the suite of proposed measures overall.

What are the pMPAs?

The four proposed MPAs are North-East Lewis and Shiant East Bank (in the North Minch), Sea of the Hebrides and Southern Trench (along the Moray and Buchan coast). The proposed protected features of the sites are shown in Table S1, and a map is provided in Figure 1. The proposed management scenarios seek to reduce risk to and disturbance of the protected features.

Table S1 Proposed Protected Features within each MPA

Site Name	Proposed Protected Features
1. North-East Lewis	▪ Risso's dolphin ▪ Sandeel ▪ Geodiversity: marine geomorphology of the Scottish shelf bed (longitudinal bedform field); Quaternary of Scotland (glaciated channels/troughs, landscape of areal glacial scour, megascale glacial lineations)
2. Sea of the Hebrides	▪ Basking shark ▪ Minke whale ▪ Fronts ▪ Geodiversity: marine geomorphology of the Scottish shelf seabed (*Inner Hebrides Carbonate Production Area*)
3. Shiant East Bank	▪ Circalittoral sands and mixed sediment communities ▪ Northern sea fan and sponge communities ▪ Shelf banks and mounds ▪ Geodiversity: Quaternary of Scotland (drumlinoid forms, glacial lineations, iceberg ploughmarks, streamlined bedrock)
4. Southern Trench	▪ Burrowed mud ▪ Minke whale ▪ Fronts ▪ Shelf deeps ▪ Geodiversity: Quaternary of Scotland (subglacial tunnel valleys and moraines; Submarine Mass Movement – slide scars)

How was the Socio-Economic Impact Assessment undertaken?

The SEIA has sought to estimate the effects of the designation and management of the four pMPAs both at site level and for the proposals as a whole in terms of:

- Potential costs to activities;
- Potential social impacts;
- Potential costs to the public sector; and
- Potential environmental impacts.

Lower, intermediate and upper estimates were developed to assess the potential range of impacts, reflecting a range of possible management options that may be applied to support achievement of site conservation objectives, as developed by Marine Scotland based on advice from Scottish Natural Heritage (SNH) and other sources, and the potential for displacement of fishing effort to result in landings that compensate for the landings lost from the site.

The estimates have been developed to help inform the impact assessment and should not be seen as prejudging the outcome of project-level additional assessments at such time as these may be required. The estimates have been used to assess the potential range in impacts associated with designation of the proposed sites.

The potential costs have been assessed for the following activities:

- Aquaculture – finfish;
- Aquaculture – shellfish;
- Carbon Capture and Storage;
- Coast Protection and Flood Defence;
- Commercial Fisheries;
- Energy Generation;
- Military Interests;
- Oil and Gas (including exploration, production, interconnectors, gas storage);
- Ports and Harbours (including dredge material disposal);
- Power Interconnectors and Transmission Lines;
- Recreational Boating;
- Shipping;
- Telecom Cables;
- Tourism; and
- Water Sports (including recreational angling, surfing, windsurfing, sea kayaking, small sail boat activities (such as dinghy sailing) and scuba diving).

Marine aggregates and aviation were scoped out of the assessment. There is currently no existing or planned marine aggregate extraction in Scottish waters and aviation was not considered by SNH to pose a significant risk to any of the site features.

Potential cost impacts have been quantified where possible for each relevant activity and pMPA, estimated in terms of additional expenditure that would be incurred and presented as Present Values (PV) over the lifetime of the assessment period (2019 to 2038). Consistent unit costs have been used within marine activity sectors as a basis for estimating these impacts, although it is recognised that the actual costs that may be incurred by specific activities within individual sites may be higher or lower than these 'average' values.

For the commercial fisheries sector, the management options for some sites may give rise to economic impacts as a result of changes in output. As a result, some of the potential cost impacts were estimated in terms of impacts to Gross Value Added (GVA). This provides a better representation of the true economic cost to these sectors. These impacts were reported as both annual average and in PV terms.

In addition to the quantified cost impacts, it is recognised that there are a number of cost impacts that cannot readily be quantified. These include:

- Costs associated with as yet unplanned development in the aquaculture, carbon capture and storage, energy generation, oil and gas, power interconnectors and telecom cable sectors;
- The potential cost impacts of delays during the consenting process arising as a result of the designations; and
- The potential deterrent to investment as a result of the designations.

It is recognised that some of these unquantified cost impacts may be at least as great as the quantified cost impacts and for some of the abovementioned sectors, the costs are therefore likely to represent only a partial estimate of costs.

The social impacts generated by the proposed management scenarios will be strongly connected to the nature, scale and distribution of the economic impacts (on both income and employment). Any significant change in employment, for example generated as a result of restrictions on fishing activity, can have significant social impacts (e.g. on health, crime). The distribution of impacts on employment in the fishing sector has focussed on the registered Home Ports of the vessels affected. The distribution of impacts on the fish processing industry has focussed on the ports of landing of the affected vessels' catches.

Public sector costs were estimated for the following broad areas based on discussions with Marine Scotland and SNH:

- Preparation of Marine Management Schemes;
- Preparation of Statutory Instruments;
- Development of voluntary measures;
- Site monitoring;
- Compliance and enforcement;
- Promotion of public understanding; and

- Regulatory and advisory costs associated with licensing decisions.

The biodiversity features of an MPA contribute to the delivery of a range of ecosystem services. Management of the MPA may improve the quantity and quality of the beneficial services provided, which may increase the value (contribution to economic welfare) of them. Impacts on the value of ecosystem services may occur as a result of the management and/or achievement of the conservation objectives of the MPA.

The ecosystem services analysis provides a qualitative description of the potential changes in ecosystem service provision associated with the implementation of management scenarios to support the achievement of conservation objectives for individual features.

The combined impact of designating the pMPAs has taken account of overlaps between the proposed designations and with existing designated sites. For other combined impacts, it has largely adopted an additive approach (i.e. it assumes that the combined impact is equivalent to the sum of the individual impacts within each site), although additional commentary has been provided where the combined impacts on specific sectors are potentially significant.

Detailed assessments for each proposed site are presented in Appendix C with an assessment of the combined impact presented in the main report (Section 8).

What are the likely significant economic and social impacts of the proposals?

Impacts to Activities

Potential cost impacts were identified for 15 different human activities within one or more proposed sites. The costs should be treated as partial as it was not possible to estimate cost impacts for all proposed management scenarios, for potential costs associated with delays or for impacts on investor confidence. The cost estimates for the intermediate scenario are considered to represent the best available estimate of quantified impacts as they reflect SNH's current best view on potential management requirements.

For commercial fisheries, the values presented represent the estimated GVA associated with the value of landings that could be affected by the management scenarios and will be overestimates if some of the effort that could be affected is displaced and fishing continues elsewhere or if less damaging gears can continue to be used within the proposed sites. The impacts will mainly be on the demersal sector, and within that sector, primarily on *Nephrops* trawls.

Given the uncertainties, confidence in the cost estimates is low, although the ranges presented across the scenarios are, for most sectors, considered to adequately capture the uncertainty. It is recognised that the actual costs that may be incurred by specific activities within individual sites may be higher or lower than the 'average' values generated within this assessment. In addition, the consequential impacts in remote or

fragile communities may have the potential to be greater than the estimates presented in this assessment.

Table S2 summarises non-GVA cost estimates by activity and by lower/ intermediate/ upper estimate[1]. Table S3 summarises estimated GVA impacts for the commercial fisheries sector. The ranges presented across the scenarios reflect the possible range of quantified costs depending on which particular site management options are selected. The main sectors that are likely to experience significant impacts under the intermediate scenario include finfish aquaculture and commercial fisheries. The largest cost impacts under the upper scenario are on the oil and gas, power interconnectors, energy generation and carbon capture and storage sectors, mostly related to potential restrictions on when survey activities can be undertaken and subsequent additional weather downtime costs.

Table S4 summarises the potential employment impacts on the commercial fisheries sector associated with estimated reductions in output.

[1] Note, for all tables of results, totals may not sum due to rounding.

Table S2. Present value (PV) in £'000 for quantified national cost impacts to human activities (costs discounted over assessment period (2019-2038), 2019 prices)

Sector	Lower Estimate	Intermediate Estimate	Upper Estimate
Aquaculture – finfish	39	269	407
Aquaculture – shellfish and seaweed	76	76	76
Carbon capture and storage	5	5	554
Coastal defence and flood protection	49	49	49
Energy generation	0	0	548
Military activities	195	195	195
Oil and gas	0	0	7,502
Ports and harbours	179	179	182
Power interconnectors and transmission lines	6	6	1,066
Recreational boating	0	0	1
Shipping	0	0	1
Telecom cables	16	16	331
Tourism	0	0	0
Water Sports	0	0	0
Total	565	796	10,913

Table S3. Impacts on GVA in £'000 for quantified cost impacts to commercial fisheries (Direct and Indirect GVA) (total costs discounted over assessment period (2019 – 2038), 2019 prices)

Sector	Lower Estimate	Intermediate Estimate	Upper Estimate
Commercial fisheries (direct GVA)	0	1,481	2,892
Commercial fisheries (direct and indirect GVA)	0	2,144	4,187

Table S4. Impacts on employment for commercial fisheries (direct and indirect employment, number of jobs)

Sector	Lower Estimate	Intermediate Estimate	Upper Estimate
Commercial fisheries (direct and indirect employment)	0.0	4.0	7.9

For most sectors, the combined impact of the designation of proposed MPAs on activities is largely considered to be additive, given the relatively low levels of impact associated with the draft management options assessed within this study.

For the commercial fisheries sector, certain fleet segments may be affected by the combined impact of multiple designations within a region (existing designations and their associated management measures, combined with these new proposals). This may be the case for over-12m and under-12m *Nephrops* trawls in the Moray and Buchan regions.

Social Impacts

For the majority of sites with management scenarios, and of ports likely to have their fishing fleets or landings affected, the estimated economic impacts are minor under the intermediate estimate. There are exceptions to this for the sites (Southern Trench), and ports (e.g. Fraserburgh) where there is a risk of small but noticeable impacts under the upper estimate.

Public Sector Costs

Table S5 presents a summary of estimated cost impacts to the public sector. The main potential costs identified relate to future monitoring costs of designated sites.

Table S5. Present value (PV) in £'000 for public sector costs (costs discounted over assessment period 2019–2038, 2019 prices)

Site Name	Quantified Cost Impact (Present Value of Total Costs, £'000)		
	Lower Estimate	Intermediate Estimate	Upper Estimate
Preparation of Marine Management Schemes	79	79	79
Preparation of Statutory Instruments	0	16	16
Development of voluntary measures	16	16	16
Site monitoring	1,144	1,144	1,144
Compliance and enforcement	0	0	0
Promotion of public understanding	0	0	0
Regulatory and advisory costs associated with licensing decisions and Review of Consents	37	37	37
Total	**1,277**	**1,293**	**1,293**

Ecosystem Services

The potential for ecosystem service benefits and costs to arise on-site or off-site has been considered. On-site benefits are the result of protection of features through the proposed management scenarios. Off-site benefits include spill-over effects, where particular species (including commercial fish or shellfish species, and other protected biodiversity) have healthier populations inside the site, and this supports movement of individuals to areas outside the site. The extent of this effect depends, amongst other things, on the size of site, impact of management measures and mobility and lifecycles of the species concerned. Ecosystem service costs could arise on-site, for example, if alternative fishing activities (using different gears) enter areas where restrictions are introduced on existing fishing activities. Costs could also arise off-site – if a significant amount of fishing activity is expected to be displaced from the site to other areas there could be a negative effect on ecosystem services outside the site.

The sites support a considerable range and value of ecosystem services, but evidence on the baseline condition of the site features, and on the expected nature of these changes in scientific or economic terms, is extremely sparse and, as a result, the assessment of changes in ecosystem services at individual sites is highly uncertain. The proposed management scenarios for the MPAs could support the level of several provisioning services, including fish (and shellfish) for human consumption, in particular from protection of sandeel habitat. The regulating services assessed (carbon sequestration and waste assimilation) are not considered significant for most sites. Cultural services including recreation may be enhanced at some sites. The displacement of fishing activity from the sites could result in detrimental effects on the

ecosystem services provided by the areas it is displaced to, but these effects would be expected to be less than the benefits in the sites because:

- The effort will usually be displaced to larger areas, so would be spread more thinly, than the pMPAs;
- The areas displaced to would overall be expected to have less sensitive and/or significant marine conservation features, as this should be the basis for site identification.

Uncertainties

All of the estimates of costs and benefits are subject to significant uncertainties. The cost estimates present a partial estimate of costs as it has not been possible to take account of unplanned future activity that will occur in a number of important sectors such as oil and gas and offshore renewables, including potential development within Option Areas for wave and tidal energy, and Areas of Search for offshore wind. The range of cost impacts varies greatly depending on the management scenarios applied. It is recognised that the actual costs that may be incurred by specific activities within individual sites may be higher or lower than the 'average' values generated within this assessment. In addition, the consequential impacts in remote or fragile communities may have the potential to be greater than the estimates presented in this assessment.

The benefits assessment is subject to particular uncertainty and it has only been possible to develop partial and tentative estimates of potential benefits for a limited number of ecosystem services.

How do I respond to the consultation?

The consultation SEIA is now open, along with the accompanying SEA Environmental Report and Sustainability Appraisal. Views and opinions on this are now invited and should be provided by 30 August 2019.

Please respond to the consultation online at: https://consult.gov.scot/marine-scotland/four-new-marine-protected-areas

If you have any enquiries please contact: Marine_Conservation@gov.scot

Or send your inquiry by post to:

pMPA Consultation
Scottish Government
Marine Planning and Policy Division
Area 1-A South

Victoria Quay
Edinburgh
EH6 6QQ

What happens next?

Following the consultation period, the responses received will be analysed, and a Post-Adoption Statement will be prepared. The Post-Adoption Statement will explain how issues raised in the SEIA, and associated views in response to the consultation, have been addressed.

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1 Introduction

1.1 Background

1.1.1 Scottish Government has made a long-term commitment to ensuring the sustainable management of the marine environment by balancing the competing interests of use and protection of the sea. This has included developing and implementing a coherent network of Marine Protected Areas (MPAs) to benefit the conservation of vulnerable and characteristic marine species and habitats in Scottish waters. The designation of MPAs is a high policy priority and fulfils duties in domestic and European legislation, as well as contributing to wider UK and international networks of protected areas.

1.1.2 Currently, there are 18 Nature Conservation MPAs designated under the Marine (Scotland) Act 2010 located inshore or within territorial waters (i.e. within 12 nautical miles (nm) of the coast)[2]. A further 13 Nature Conservation MPAs are designated in the offshore environment (i.e. from 12nm off the coast, or within non-territorial waters)[3]. One Demonstration and Research MPA is designated under the Marine (Scotland) Act 2010[4]. There are also 8 historic MPAs that are designated for nationally important historic assets, predominately shipwrecks[5].

1.1.3 Four additional MPAs are intended to extend the existing MPA network. These were originally introduced for consideration as areas of search in 2012. However, it was concluded that additional information and advice was required to inform the selection of MPAs from within these areas of search, and this was subsequently provided by SNH[6]. In light of that advice, all four areas are now being proposed for designation as MPAs. The designation of these four proposed MPAs (pMPAs) is the subject of this Social and Economic Impact Assessment (SEIA) Report.

[2] SNH (2017) Nature Conservation Marine Protected Areas [online] Available at: http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/national-designations/mpas/ (accessed 17/10/2018)

[3] JNCC (2015) Nature Conservation Marine Protected Areas (MPAs) [online] Available at: http://jncc.defra.gov.uk/page-5269 (accessed 17/10/2018)

[4] Marine Scotland (2016) Fair Isle Demonstration and Research MPA Consultation [online] Available at: https://www.gov.scot/Topics/marine/marine-environment/mpanetwork/DandRMPAs/FairIsleDRMPA (accessed 17/10/2018)

[5] Historic Environment Scotland (2016). Scotland's Historic Marine Protected Areas 2016.

[6] SNH (2014) Commissioned Report No. 780: Further advice to Scottish Government on the selection of Nature Conservation Marine Protected Areas for the development of the Scottish MPA network [online] Available at: https://www.nature.scot/sites/default/files/2017-07/Publication%202014%20-%20SNH%20Commissioned%20Report%20780%20-%20Further%20advice%20to%20Scottish%20Government%20on%20the%20selection%20of%20Nature%20Conservation%20Marine%20Protected%20Areas%20for%20the%20development%20of%20the%20Scottish%20MPA%20network.pdf (accessed 17/10/2018)

1.2 Social and Economic Impact Assessment

1.2.1 The purpose of the SEIA is to identify and assess the potential economic and social effects of a proposed development or policy on the lives and circumstances of people, their families and their communities. It considers the potential economic benefits and costs, and their distribution among different groups, to inform the assessment of potential impacts on individuals, communities and society.

1.2.2 This study aims to assess the potential economic and social effects of the proposed designation and management of four MPAs.

1.2.3 The objectives of the study were, for each individual MPA:

- identify the activities taking place, and the activities that could be affected by designation of each proposed site and how;
- Identify and estimate the costs to potentially affected activities, specifically arising from the proposed management scenarios for each pMPA;
- Identify any communities and social groups that may be adversely or positively affected by designation proposals, and quantify the scale and costs of such impacts where possible;
- Estimate the costs to government (public sector costs) associated with the designation and management of the sites;
- Identify, describe and quantify the potential costs and benefits to society as a whole associated with designation of each individual site.

1.2.4 Based on the individual MPA impact assessments, a combined assessment is also required to estimate the potential aggregate costs of designation and management of the 4 pMPAs as a whole and the combined impact on potentially affected marine activities, communities, social groups and Government.

1.2.5 A cumulative assessment is also required to present information on the potential total impact as a result of all MPAs and other planned projects such as renewable energy development to date.

1.2.6 The assessment provides Marine Scotland with evidence on economic and social effects to inform a Business and Regulatory Impact Assessment (BRIA), and a Sustainability Appraisal for the proposals.

1.3 Purpose and Structure of this Report

1.3.1 The purpose of this report is to document the findings of the SEIA. A Strategic Environmental Assessment (SEA) of the proposed management scenarios has also been undertaken and is reported separately. The key findings of both the

SEA and the SEIA are summarised in an overall Sustainability Appraisal (SA) document.

1.3.2 The remainder of this Socio-Economic Impact Assessment Report is structured as follows:

- Section 2 provides information on the proposed designation and management of pMPAs and their policy context;
- Section 3 describes the approach to the SEIA and the methods used;
- Section 4 presents the results of the assessment in relation to potential impacts on activities that could be affected by the designation and management of the pMPAs;
- Section 5 presents the potential impacts on the public sector;
- Section 6 presents the distribution of economic costs and consequent social impacts;
- Section 7 presents the potential impacts on ecosystem services;
- Section 8 considers the potential combined impacts of the proposals and the cumulative impacts with other planned projects and proposals; and
- Section 9 presents the limitations and uncertainties in the assessment.

1.3.3 The Non-Technical Summary precedes Section 1. Further detailed information is provided in Appendices as follows:

- Appendix A: Sector context, assumptions and assessment approach;
- Appendix B: Public sector costs;
- Appendix C: Site Assessment Tables (providing detailed assessments for each site);
- Appendix D: Management Scenarios; and
- Appendix E: Abbreviations.

2 Marine Protected Areas

2.1 Background

2.1.1 Scotland's seas host an estimated 6,500 varieties of marine flora and fauna, making them among the most species rich in the world[7]. Furthermore, several sites are strongholds for UK populations of particular species, such as breeding seabirds and fan mussels[8]. The long-term biological success of these species is heavily dependent on having assured access to high quality habitats. For highly mobile species such as cetaceans and sharks, such habitats are likely to be found across a range of geographical locations and environmental conditions, each supporting a different key life cycle activity such as breeding, feeding, courtship, or raising young[9]. However, Scotland's marine environment faces pressures to its health and productivity from climate change, commercial fishing, pollution, and the loss of coastal and estuary habitat to development[10].

2.1.2 The MPA network is intended to benefit the marine environment, historic features, coastal communities, marine industries, and recreational users[11]. In total, it consists of 231 sites covering 22% of Scotland's seas[12]. The network comprises Special Areas of Conservation (SAC), Special Protection Areas (SPAs), Sites of Special Scientific Interest (SSSI), and MPAs (Nature Conservation, Historic, and Demonstration and Research)[13].

2.1.3 Nature Conservation MPAs seek to ensure that nationally important marine wildlife, habitats, geology, and undersea landforms receive adequate protection against disturbance and degradation[14]. Specifically, they aim to either conserve

[7] ClimateXChange (2016) How is climate change impacting on Scotland's marine environment, infrastructure and industry? [online] Available at: https://www.climatexchange.org.uk/media/2346/marine_and_coastal_change.pdf (accessed 17/10/2018)

[8] ibid

[9] SNH (2014) Commissioned Report No. 780: Further advice to Scottish Government on the selection of Nature Conservation Marine Protected Areas for the development of the Scottish MPA network [online] Available at: https://www.nature.scot/sites/default/files/2017-07/Publication%202014%20-%20SNH%20Commissioned%20Report%20780%20-%20Further%20advice%20to%20Scottish%20Government%20on%20the%20selection%20of%20Nature%20Conservation%20Marine%20Protected%20Areas%20for%20the%20development%20of%20the%20Scottish%20MPA%20network.pdf (accessed 17/10/2018)

[10] Scotland's Environment (2014) Scotland's State of the Environment Report, 2014 [online] Available at: https://www.environment.gov.scot/media/1170/state-of-environment-report-2014.pdf (accessed 17/10/2018)

[11] ibid

[12] Scottish MPA Network – Parliamentary Report [online] Available at: https://www.gov.scot/publications/marine-protected-area-network-2018-report-scottish-parliament/ (accessed 28/01/2019)

[13] Scottish Government (2017) Marine Protected Areas (MPAs) [online] Available at: http://www.gov.scot/Topics/marine/marine-environment/mpanetwork (accessed 17/10/2018)

features or remove pressures in order to allow them to recover. They also contribute to the survival and maintenance of species of international significance by complementing other systems of protection, both spatially and through the alignment of conservation objectives[15].

2.2 Designation of the MPA network to date

2.2.1 The Marine (Scotland) Act 2010[16] and the Marine and Coastal Access Act 2009[17] gave Scottish Ministers powers to designate MPAs in Scottish territorial and offshore waters, respectively. To inform this process, the Scottish MPA Project was established to ensure MPAs are designated in the most appropriate locations for their particular objectives. SNH is responsible for providing advice on Nature Conservation MPAs in Scottish territorial waters, while the Joint Nature Conservation Committee (JNCC) advises on possible designations in the offshore environment[18].

2.2.2 In 2012, SNH and JNCC submitted advice to the Scottish Government on 33 proposed MPAs in both the inshore and offshore environment, as well as four areas of search[19]. The proposals were subject to public consultation in the summer of 2013 as part of Marine Scotland's integrated 'Planning Scotland's Seas' process, which sought views on marine planning, Sectoral Marine Plans for offshore renewable energy, and MPAs and Priority Marine Features (PMFs)[20]. An SEA Environmental Report, which looked at the potential environmental effects of the designations, was among the suite of consultation documents made available at this time[21].

2.2.3 The Environmental Report noted that adverse environmental effects were most likely to arise from the introduction of fisheries management measures within the MPAs. Specifically, it was considered that these measures could potentially lead to the displacement of fishing activity[22] (namely the use of bottom-contact

[15] Scottish Government (2017) Marine Protected Areas (MPAs) [online] Available at: http://www.gov.scot/Topics/marine/marine-environment/mpanetwork (accessed 17/10/2018)

[16] Scottish Government (2017) Marine (Scotland) Act [online] Available at: http://www.gov.scot/Topics/marine/seamanagement/marineact (accessed 17/10/2018)

[17] Scottish Government (2014) Marine and Coastal Access Act 2009 [online] Available at: http://www.gov.scot/Topics/marine/seamanagement/marineact/ukbill (accessed 17/10/2018)

[18] SNH/JNCC (2012) Commissioned Report No. 547: Advice to the Scottish Government on the selection of Nature Conservation Marine Protected Areas (MPAs) for the development of the Scottish MPA network [online] Available at: http://www.snh.org.uk/pdfs/publications/commissioned_reports/547.pdf (accessed 17/10/2018)

[19] ibid

[20] Scottish Government (2015) Planning Scotland's Seas [online] Available at: http://www.gov.scot/Topics/marine/seamanagement/national/marine-consultation (accessed 17/10/2018)

[21] Scottish Government (2013) Planning Scotland's Seas: 2013 - Possible Nature Conservation Marine Protected Areas Consultation Overview - Strategic Environmental Assessment Report [online] Available at: http://www.gov.scot/Publications/2013/08/2591 (accessed 17/10/2018)

[22] Scottish Government (2013) Planning Scotland's Seas: 2013 – Possible Nature Conservation Marine Protected Areas Consultation Overview – Strategic Environmental Assessment Report [online] Available at: http://www.gov.scot/Publications/2013/08/2591/0 (accessed 17/10/2018)

mobile, static, and hydraulic fishing gear[23]), introducing or intensifying pressures in other areas. However, due to a lack of detail regarding the potential nature and volume of displacement, the assessment was unable to reach a conclusion as to the likely significance of these effects[24]. A commitment was therefore made to complete the SEA once this information became available.

2.2.4 Following on from this consultation and additional advice received from SNH and JNCC[25], 30 of the original 33 prospective Nature Conservation MPAs were formally designated by Scottish Ministers in July 2014: 17 in the inshore environment and 13 in the offshore environment.

2.2.5 Draft management measures were subsequently developed and an addendum to the original 2013 Environmental Report was published in November 2014[26]. This built upon the findings of an accompanying fisheries displacement study to explore the potential environmental effects associated with the proposed management measures. The Environmental Report addendum and the outputs of additional consultations fed into the finalisation of the first phase of fisheries management measures, which were implemented in early 2016[27].

2.2.6 The SEA of the second phase of management measures commenced in October 2017 and work on both the development of the management measures and the SEA is ongoing. The management measures are expected to come into force in 2019.

2.2.7 In addition to the 30 MPAs designated in 2014, Ministers issued an Order to immediately designate an additional emergency MPA in Loch Carron following damage to the world's largest expanse of flame shell beds due to commercial fishing activity in 2017[28]. This was the first such instance of Ministers invoking powers under the Marine (Scotland) Act 2010 to immediately designate an

[23] Scottish Government (2014) Proposals for Fisheries Management Measures in Special Areas of Conservation – Screening and Scoping Report [online] Available at: http://www.gov.scot/Topics/Environment/environmental-assessment/sea/SEAG (accessed 17/10/2018)

[24] ibid

[25] SNH (2014) SNH's advice on selected responses to the 2013 Marine Scotland consultation on Nature Conservation Marine Protected Areas (MPAs) [online] Available at: https://www.nature.scot/sites/default/files/2017-07/Publication%202014%20-%20SNH%20Commissioned%20Report%20747%20-%20SNH%27s%20advice%20on%20selected%20responses%20to%20the%202013%20Marine%20Scotland%20consultation%20on%20Nature%20Conservation%20Marine%20Protected%20Areas%20%28MPAs%29.pdf (accessed 17/10/2018)

[26] Scottish Government (2014) MPA/SAC Consultation Environmental Assessment [online] Available at: http://www.gov.scot/Topics/marine/marine-environment/mpanetwork/MPAMGT/consultation2014/ManagementSEA (accessed 17/10/2018)

[27] Scottish Government (2017) Inshore MPAs/SACs [online] Available at: http://www.gov.scot/Topics/marine/marine-environment/mpanetwork/inshorempas (accessed 17/10/2018)

[28] Scottish Government (2018) Protection for world's biggest plan shell bed [online] Available at: https://news.gov.scot/news/protection-for-worlds-biggest-flame-shell-bed (accessed 17/10/2018)

MPA[29]. However, the current designation is temporary and will expire in 2019[30]. The potential to designate Loch Carron as a permanent MPA was the subject of a recent public consultation which ran to 13 June 2018.

[29] SNH (2017) Loch Carron Urgent Nature Conservation Marine Protected Area (NCMPA) [online] Available at: https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-areas/national-designations/marine-protected-areas/nature-conservation-2 (accessed 17/10/2018)

[30] SNH (2017) Loch Carron possible MPA [online] Available at: https://www.nature.scot/loch-carron-possible-mpa (accessed 17/10/2018)

2.3 Proposals for four additional pMPAs

2.3.1 As stated earlier, the pMPAs were initially introduced for consideration as areas of search, with the expectation these would lead to four additional MPAs that, when designated, would complete the network. Specifically, the pMPAs would extend protection to basking shark, minke whale, Risso's dolphin, burrowed mud, shelf banks and mounds, and shelf deeps. However, at the time MPA advice was provided in 2012, SNH concluded that additional assessment work would be needed before formal advice could be provided to Scottish Ministers[31].

2.3.2 Habitat modelling, basking shark tagging, and additional seabed habitat surveying were carried out and presented in further advice to Scottish Ministers in 2014[32]. The findings served to both corroborate and revise existing conclusions as to the presence and density of protected features as well as the extent to which they rely on particular areas to support key life cycle activities. In assessing the areas of search against the MPA Selection Guidelines, SNH looked at the following criteria: representation, replication, resilience, range and geographic variation of features, and any key linkages[33].

2.3.3 As a result of this additional research, the sites were eventually modified, either in terms of their boundaries or their proposed protected features, and a recommendation was made that all four sites be designated as MPAs[34].

2.3.4 The proposed designation of these MPAs is the subject of this present assessment. Table 6 below provides a description of the four pMPAs, including their general location, proposed protected features, and draft conservation objectives. Figure 1 provides a map of the location of the pMPAs.

[31] SNH (2012) Commissioned Report No. 547: Advice to Scottish Government on the selection of Nature Conservation Marine Protected Areas (MPAs) for the development of the Scottish MPA network [online] Available at: https://www.nature.scot/sites/default/files/2017-07/Publication%202012%20-%20SNH%20Commissioned%20Report%20547%20-%20SNH%20and%20JNCC%20MPA%20network%20advice.pdf (accessed 17/10/2018)

[32] SNH (2014) Commissioned Report No. 780: Further advice to Scottish Government on the selection of Nature Conservation Marine Protected Areas for the development of the Scottish MPA network [online] Available at: https://www.nature.scot/sites/default/files/2017-07/Publication%202014%20-%20SNH%20Commissioned%20Report%20780%20-%20Further%20advice%20to%20Scottish%20Government%20on%20the%20selection%20of%20Nature%20Conservation%20Marine%20Protected%20Areas%20for%20the%20development%20of%20the%20Scottish%20MPA%20network.pdf (accessed 17/10/2018)

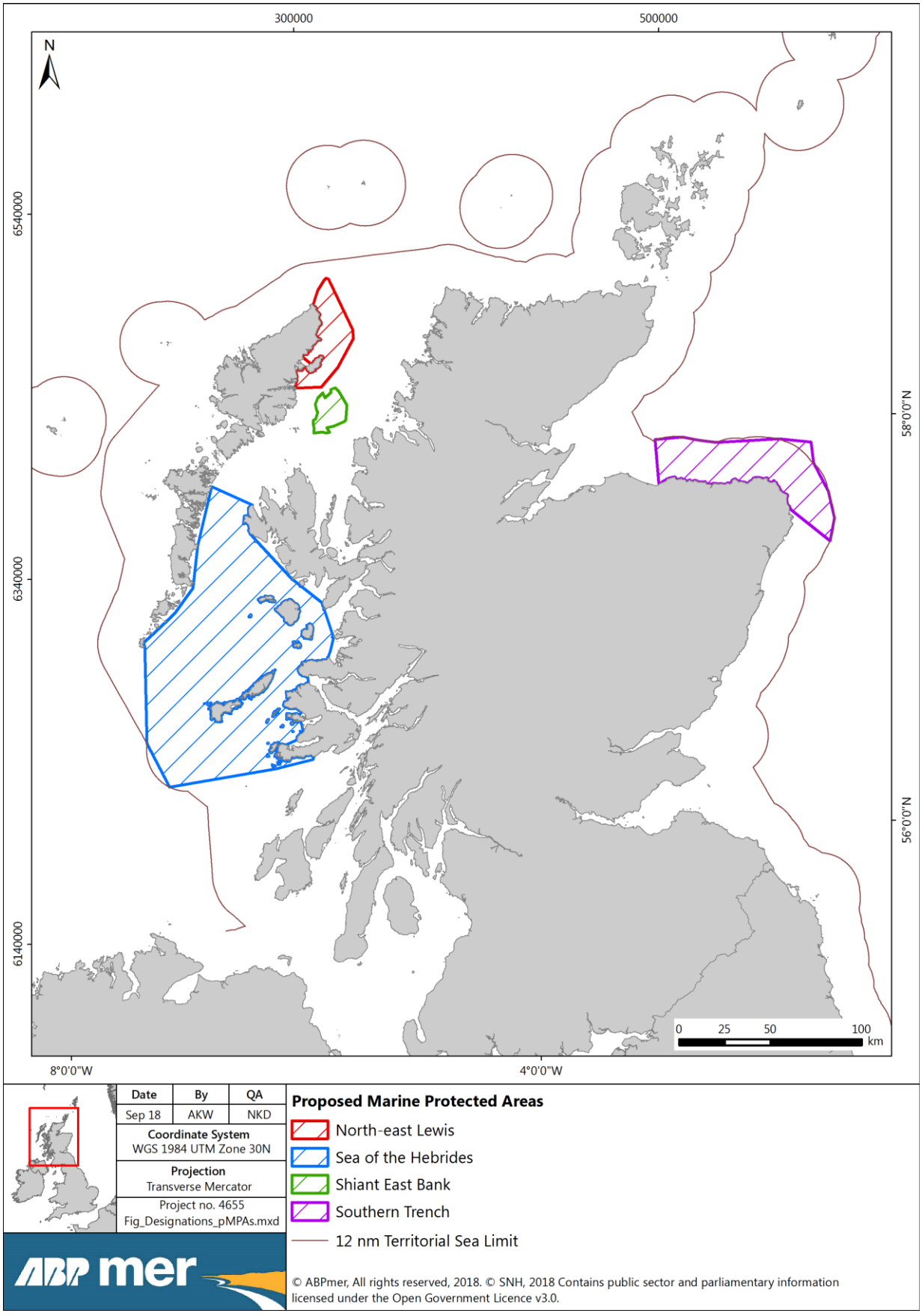
[33] Scottish Government (2011) Marine Protected Areas in Scotland's Seas: Guidelines on the selection of MPAs and the development of the MPA network [online] Available at: http://www.gov.scot/Resource/0051/00515466.pdf (accessed 17/10/2018)

[34] SNH (2017) Scottish Marine Protected Areas Project [online] Available at: https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-areas/national-designations/marine-protected-areas/scottish-marine-protected-0 (accessed 17/10/2018)

Table 6. Characteristics of the four pMPAs under assessment

pMPA	Proposed protected feature	Draft conservation objectives
North-east Lewis (NEL)	Biodiversity: Risso's dolphin; sandeel	Conserve
	Geodiversity: marine geomorphology of the Scottish shelf bed (*longitudinal bedform field*); Quaternary of Scotland (*glaciated channels/troughs, landscape of areal glacial scour, megascale glacial lineations*)	
Sea of the Hebrides (SOH)	Biodiversity: basking shark; minke whale; fronts	Conserve
	Geodiversity: marine geomorphology of the Scottish shelf seabed (I*nner Hebrides Carbonate Production Area*)	
Shiant East Bank (SEB)	Biodiversity: circalittoral sands and mixed sediment communities; Northern sea fan and sponge communities; Shelf banks and mounds	Conserve
	Geodiversity: Quaternary of Scotland (*drumlinoid forms, glacial lineations, iceberg ploughmarks, streamlined bedrock*)	
Southern Trench (STR)	Biodiversity: burrowed mud; minke whale; fronts; shelf deeps	Conserve
	Geodiversity: Quaternary of Scotland (*subglacial tunnel valleys and moraines; Submarine Mass Movement – slide scars*)	

Figure 1 Map of the four pMPAs



3 Approach to the Assessment

3.1 Introduction

3.1.1 The methodology applied has built on previous marine socio-economic assessments for MPAs, particularly the assessment of Scottish Nature Conservation MPAs[35], and the assessment of phase 2 fisheries management measures in Nature Conservation MPAs[36]. It is consistent with Better Regulation Executive guidance on impact assessment, the Green Book methodology[37] for economic assessment and Scottish Government guidance on Business and Regulatory Impact Assessment (BRIA)[38]. An overview of the approach is shown in Figure 2.

3.1.2 The methodology covers:

- General project assumptions;
- Establishing a baseline against which impacts can be assessed;
- Assessment of costs and benefits for each site; and
- Combined assessment.

[35] Marine Scotland, 2013. Planning Scotland's Seas: 2013 - The Scottish Marine Protected Area Project – Developing the Evidence Base tor Impact Assessments and the Sustainability Appraisal Final Report.

[36] Marine Scotland, 2018. Proposed Inshore MPA/SAC Fisheries Management Measures – Phase 2. Socio-Economic Impact Assessment. October 2018. Report prepared by ABPmer & eftec for the Scottish Government.

[37] HM Treasury, 2018. The Green Book. Central Government Guidance on Appraisal and Evaluation. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

[38] https://beta.gov.scot/publications/bria-guidance/.

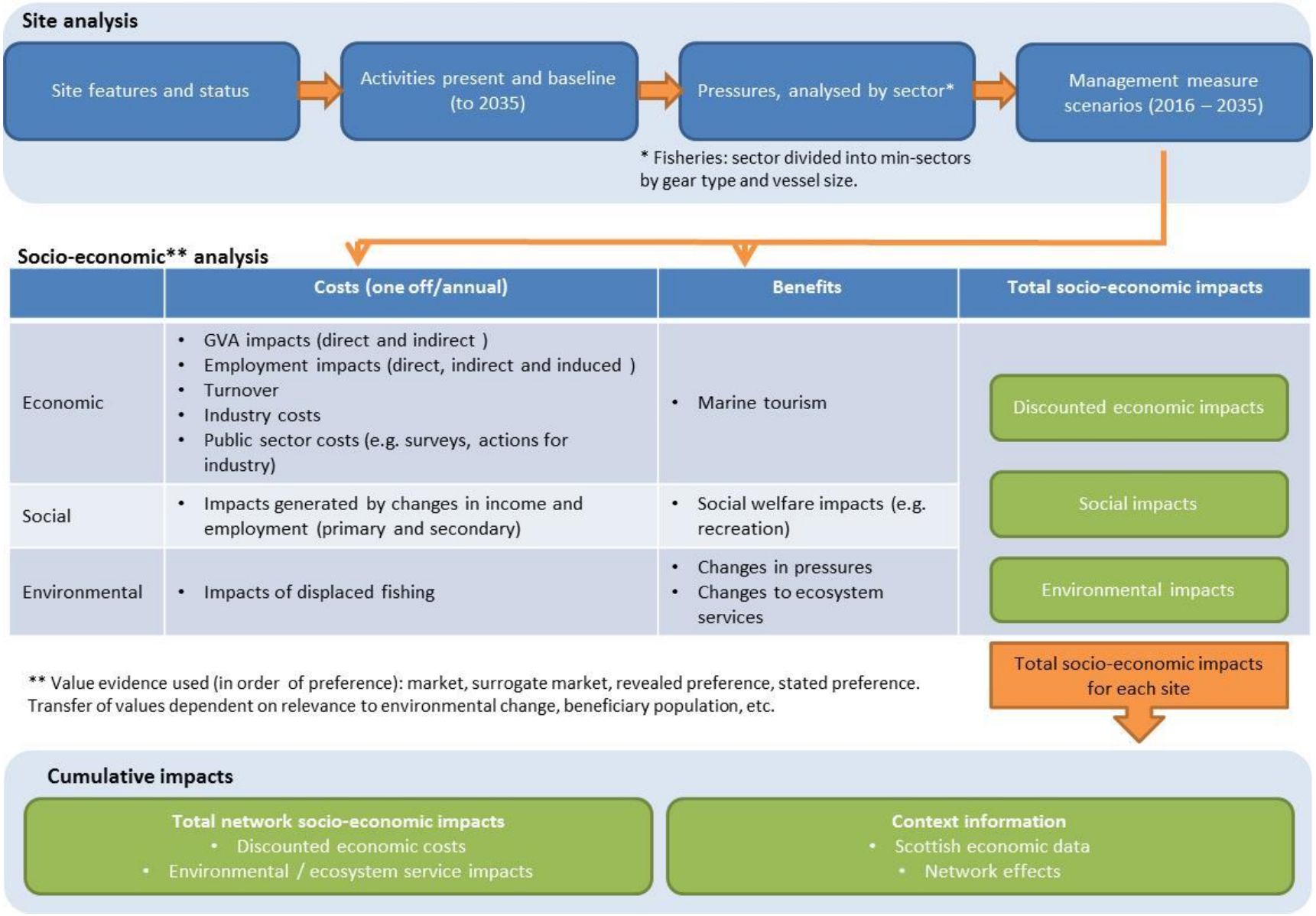


Figure 2 Economic and Social Analysis Process

3.2 General Project Assumptions

3.2.1 A number of key assumptions were developed in consultation with Marine Scotland which have informed the progression of the study.

3.2.2 Lower, intermediate and upper estimates have been developed to assess the potential range of impacts, which reflect a range of possible management options that may be applied. The management options have been developed for the purposes of the assessment by Marine Scotland based on advice from Scottish Natural Heritage (SNH) and other sources. They take into account the sensitivity of features proposed for designation in relation to the scale and intensity of pressures associated with human activities, but do not anticipate final advice on management measures, nor do they reflect the management measures that may be adopted by the Scottish Government for individual sites. The assumptions used for each sector and each estimate are documented in Appendix C. Impacts have been assessed for the lower, intermediate and upper estimates compared to the 'do nothing' option, i.e. not to proceed with the proposed designations.

3.2.3 It has been assumed that sites will be designated in 2019 and costs will be first experienced in 2020, with the exception of costs associated with additional licensing requirements which will apply from 2019. Costs and GVA impacts are expressed in 2019 prices using the latest Gross Domestic Product (GDP) deflator data[39].

3.2.4 An assessment period of 20 years following designation has been selected as providing a reasonable time period within which the main impacts are likely to occur. Beyond this time period, socio-economic effects and environmental impacts become less certain. For socio-economic effects, this is due to technological changes and the ability of industries to adapt (e.g. as capital depreciates and is replaced), amongst other things. For environmental impacts, environmental responses are harder to predict based on current knowledge and due to external influences (e.g. climate change). The assessment period therefore runs from 2019 to 2038.

3.2.5 Monetary impacts have been discounted over the assessment period using a 3.5% discount rate in line with the Green Book. Employment impacts have not been discounted so that the full impact on employment is clear.

3.2.6 The assessment has sought to ensure consistency between the lower, intermediate and upper estimates used in the SEIA, and the reasonable alternatives assessed in the SEA.

[39] GDP deflator data from June 2018 includes the forecasted percentage change in GDP deflator for 2018 to 2022. Taken from the Office for Budgetary Responsibility (OBR) forecasts for GDP deflator increases as of March 2018 Economy supplementary tables. http://obr.uk/efo/economic-fiscal-outlook-march-2018/.

3.3 Establishing a Baseline

3.3.1 In order to undertake the socio-economic assessment, a range of baseline information is required. Given that the assessment relates to impacts over time, a dynamic baseline is needed which indicates how baseline conditions might change over the time period of the assessment. Assuming designation in 2019 and an assessment covering a 20 year period, a baseline has been created covering the period from 2019 to 2038.

3.3.2 The baseline work has built on the work previously carried out for the Nature Conservation MPA assessment[40] in terms of the types of information required, but has been focused on the specific geographical areas relating to the four pMPAs.

3.3.3 A range of baseline information was collated, including:

- The distribution of biodiversity and geodiversity features within and adjacent to the pMPAs and how this might change over the assessment period (in the absence of the intervention);
- The distribution and intensity (number of sites/volume/value) of human activities within and adjacent to the pMPAs and how this might change over the assessment period (in the absence of the intervention); and
- Information on ecosystem service values associated with the marine environment and how these may change over the assessment period (in the absence of the intervention).

Biodiversity and geodiversity features

3.3.4 SNH provided information on the distribution of biodiversity and geodiversity features, including population estimates for marine mammals, and area estimates for habitats and geodiversity features where available.

3.3.5 These data sources were used to develop a best understanding of the spatial distribution of the biodiversity and geodiversity features for which each pMPA site is being proposed.

Human Activities

3.3.6 Relevant data on the spatial distribution and intensity of marine activities occurring within and adjacent to the pMPA sites was collated within ArcGIS. This included the following activities:

- Aquaculture (finfish);
- Aquaculture (shellfish);
- Carbon Capture and Storage;
- Coast Protection and Flood Defence;

[40] Marine Scotland, 2013. Planning Scotland's Seas: 2013 - The Scottish Marine Protected Area Project – Developing the Evidence Base tor Impact Assessments and the Sustainability Appraisal Final Report.

- Commercial Fisheries (including salmon and sea trout);
- Energy Generation;
- Military Interests;
- Oil and Gas (including exploration, production, interconnectors, gas storage);
- Ports and Harbours;
- Power Interconnectors;
- Recreational Boating;
- Shipping;
- Telecom Cables;
- Tourism (including heritage assets); and
- Water Sports.

3.3.7 The baseline has taken account of possible changes in the distribution and intensity of human activity over the time period of the assessment to provide a dynamic baseline. This has drawn on previous work to develop a dynamic baseline for the Nature Conservation MPA assessment[41]. In considering potential future development activity, various assumptions have been made and documented in Appendix A.

3.3.8 Aviation was scoped out of the baseline assessment on the basis that SNH advised that no management measures would be required for this sector. Marine aggregates has also been scoped out of the baseline as there are no current marine aggregate licences or licence applications in Scottish waters.

3.3.9 Key data sources included:

- Marine Scotland's NMP Interactive (NMPi);
- Information from The Crown Estate on Lease and Agreement-for-Lease locations;
- Kingfisher Cables;
- Oil and Gas Authority (OGA) Oil and Gas licensing round awards;
- Oil and Gas pipeline data (Common Data Access Ltd, 2018);
- Royal Yachting Association (RYA) Sailing/cruising routes;
- National Flood and Coast Defence Database;
- Eurosion Database;

[41] Marine Scotland, 2013. Planning Scotland's Seas: 2013 - The Scottish Marine Protected Area Project – Developing the Evidence Base tor Impact Assessments and the Sustainability Appraisal Final Report.

- Automatic Identification System shipping data[42];
- Processed UK commercial fisheries vessel VMS ping data for the five years 2012–2016 broken down by gear type and linked to estimated landings for vessels over 12m in length (provided by Marine Scotland);
- ICES rectangle landings data for fishing vessels 12m and under broken down by gear type;
- Scotmap data for UK fishing vessels under 15m in length;
- Military practice and exercise areas (PEXA) and military establishments from British Crown, Oceanwise and Defence Infrastructure Organisation.

3.3.10 All data were stored and managed in accordance with good practice.

Other information requirements

3.3.11 In addition to baseline data, a range of additional data and information has been required to inform the assessment. In particular, information on licensing costs and the cost of potential management measures has been required to estimate cost impacts for activities, together with information on enforcement, surveillance and monitoring costs to estimate impacts on the public sector. Such information has been obtained from the Nature Conservation MPA assessment[43], Defra's Marine Conservation Zone Impact Assessment[44], and the Impact Assessment that accompanied the Marine (Scotland) Act[45]. Additional information was sought from specific marine sectors where required.

3.4 Assessment of Costs and Benefits

Economic Impacts to Marine Activities

3.4.1 Detailed assessment methods for relevant marine activities scoped in to the assessment at one or more proposed sites are presented in Appendix A.

3.4.2 All the methods generally entail making estimates of the cost of implementing management scenarios and/or the impact of implementing the management scenarios on operating revenues. Consistent unit costs have been used within most marine activity sectors as a basis for estimating these impacts, although it is recognised that the actual costs that may be incurred by specific activities within individual sites may be higher or lower than these 'average' values.

3.4.3 For some sectors, there may also be impacts associated with delays in consenting as a result of the designations or impacts on investor confidence.

[42] AIS data published under Open Government Licence. Reproduced with permission of the MCA and MMO.

[43] Marine Scotland, 2013. ibid.

[44] Defra, 2012. Designation of Marine Conservation Zones in English Inshore Waters and English and Welsh Offshore Waters. Impact Assessment. IA No: Defra 1475. December 2012.

[45] Risk & Policy Analysts & ABPmer, 2009. Full Regulatory Impact Assessment: Scottish Marine Bill. Final Report. March, 2009.

However, it has not been possible to quantify these potential impacts as it is not possible to predict whether or where they might occur. It is recognised that these costs could potentially be large for some sectors and possibly larger than some of the costs that have been quantified.

3.4.4 Where possible, all impacts have been quantified in monetary terms, with these values converted to 2019 prices using the relevant GDP deflators. Where impacts on economic activities have the potential to give rise to a change in the level of output, direct and indirect impacts on Gross Value Added (GVA) and employment have been estimated using appropriate multipliers. This is only the case for the fisheries sector, which is the only sector for which the management scenarios have the potential to affect output through loss of landings.

3.4.5 The impacts for all the relevant activities for each site are documented in Tables 3 (cost impacts) and 4 (potential benefits) of Appendix C. Sectors that are unaffected are recorded in Table 5 of Site Reports in Appendix C.

Social impacts on individuals, communities and society

3.4.6 Social impacts are effects on individuals, communities and society. They can vary in their desirability, scale, extent or duration (temporal and spatial), intensity and severity, as well as the extent to which they affect particular groups or are compounded by cumulative effects.

3.4.7 The social impacts generated by the proposed management scenarios will be strongly connected to the nature, scale and distribution of the economic impacts (on both income and employment). Any significant change in employment, for example generated as a result of restrictions on fishing activity, can have significant social impacts (e.g. on health, crime). Economic and social impacts have been assessed through a distributional analysis.

3.4.8 Employment is recognised as being a particularly important generator of social benefit. It is the key means by which individuals fulfil material wellbeing, as well as being central to social linkages, individual identity, social status and an important contributor to physical and mental health. Conversely, unemployment can be detrimental to physical and mental health and a key cause of deprivation and associated issues of community cohesion.

3.4.9 The distribution of impacts on employment in the fishing sector has focussed on the registered Home Ports of the vessels affected. The distribution of impacts on the fish processing industry has focussed on the ports of landing of the affected vessels' catches.

3.4.10 The distributional analysis has focused exclusively on the commercial fishing sector (and the fish processing sector) as the main sector affected. The analysis quantifies the estimated economic costs of management scenarios (on output, GVA and employment).

3.4.11 The focus of the distributional analysis was predominantly on groups in Scotland, as this is where the majority of impacts are expected to occur. This has included impacts on specific locations (including regions, districts and

ports) and on specific groups within Scotland's population (including, for example, different age groups, genders, minority groups, and parts of Scotland's income distribution). Table 7 summarises the list of groups that have been considered in the distributional analysis.

Table 7. Groups who may be affected by fisheries management scenarios

Location	Fishing group	Groups distinguished by:			
		Age	Income	Social groups	Gender
Region Port Rural/ urban/ mainland or island	Gear type Vessel size	Children Working age Pensionable age	10% most deprived 10% most affluent Remaining 80%	e.g. Crofters Ethnic minorities With disability or long-term sick	Male Female

3.4.12 The report presents social interaction tables and evidence for 14 marine sector and sub-sectors (which are broadly similar to the sectors/activities occurring within, and adjacent to, the pMPAs). Each table represents the potential interactions that a given sector is susceptible to, and describes the pathways that can lead to primary and secondary social impacts. Each table is also supported by evidence on the impact pathways and social impacts, which is based on the currently available literature as well as stakeholders' views.

3.4.13 The social impact assessment presented in Section 6 uses the relevant impact-interaction tables to identify the potential social impacts of designating the pMPAs, for the commercial fisheries sector where designation is expected to have GVA and employment impacts. For this sector, the tables identify the potential distribution of economic impacts and any subsequent social impacts.

3.4.14 The tables are then combined with relevant quantitative (e.g. potential employment impacts) and qualitative information to assess whether social impacts are likely to occur, and if so, the potential significance of the social impacts identified. Mitigation measures for potentially significant social impacts are also highlighted.

3.4.15 The significance of the social impacts has been assessed using the following definitions:

- xxx/+++: significant negative/positive effect; This is defined as where it is probable that an impact will be noticed and is potentially significant;
- xx/++: possible negative/positive effect This is defined as where it is possible than an impact will be noticed;
- +/-: minimal effect, if any. This is defined as where it is probable than an impact is unlikely to be sufficiently significant so as to be noticeable, but that some possibility exists that a negative/positive impact could occur; and

- 0: no noticeable effect expected.

3.4.16 The social impact assessment is conducted for each individual pMPA and for the suite of pMPAs as a whole. The results of the social impact assessment for each site are reported in Table 6 of Sire Reports in Appendix C.

Impacts on the public sector

3.4.17 Following a decision to designate individual sites, costs may be incurred by the public sector in the following broad areas, although not all measures listed will be needed at all sites, i.e. these requirements are site-specific:

- Preparation of Marine Management Schemes;
- Preparation of Statutory Instruments;
- Development of voluntary measures;
- Site monitoring;
- Compliance and enforcement;
- Promotion of public understanding; and
- Regulatory and advisory costs associated with licensing decisions and review of consents.

3.4.18 Standard assumptions have been developed for the estimation of public sector cost impacts for each site based on information contained within the Final Regulatory Impact Assessment for the Marine (Scotland) Bill[46], information from the Marine Conservation Zones Impact Assessment[47], information from the previous impact assessment of Nature Conservation MPAs[48] and informal discussions with Marine Scotland and SNH (see Appendix B). These agreed assumptions have then been used to estimate costs to central government for each site and all sites combined.

3.4.19 Consideration has then been given to opportunities where more local management may be appropriate and how the costs and benefits may differ following such an approach.

3.4.20 The estimated public sector cost impacts for each site are documented in Table 7 of Site Reports in Appendix C.

Impacts on ecosystem services

3.4.21 The biodiversity features of an MPA contribute to the delivery of a range of ecosystem services. Management of the MPA may improve the quantity and quality of the beneficial services provided, which may increase the value (contribution to economic welfare) of them. Impacts on the value of ecosystem

[46] Scottish Government, 2009. Final Regulatory Impact Assessment for the Marine (Scotland) Bill.

[47] Finding Sanctuary, Irish Seas Conservation Zones, Net Gain and Balanced Seas. 2012. Impact Assessment materials in support of the Regional Marine Conservation Zone Projects' Recommendations.

[48] Marine Scotland, 2013. Planning Scotland's Seas: 2013 - The Scottish Marine Protected Area Project – Developing the Evidence Base tor Impact Assessments and the Sustainability Appraisal Final Report.

services may occur as a result of the management and/or achievement of the conservation objectives of the MPA.

3.4.22 The ecosystem services analysis has provided a qualitative description of the potential changes in ecosystem service provision associated with the implementation of management scenarios to support the achievement of conservation objectives for individual features. The ecosystem services analysed are based on those used in previous Scottish MPA impact assessments, but updated to reflect the latest evidence and terminology used by SNH (C. Leakey, *pers. comm.*). The list of final ecosystem services that have been considered is described in Section 7.

3.4.23 The analysis of changes to ecosystem services has considered both on-site and off-site impacts of management scenarios. Off-site impacts could be positive (e.g. by supporting healthier fish stocks in the area) or negative (e.g. due to the impacts of displaced fishing vessels). On-site costs could arise as a result of alternative fishing gears (e.g. pots) being deployed in MPAs where management has excluded other gears. Examples of these impacts are discussed in Section 7.

3.4.24 In assessing impacts, we have sought to clearly link the management scenarios ('lower' to 'upper') to changes in ecosystem services and the economic value of these. The analysis has been summarised in an assessment table (Tables 6a and 6b in Appendix C), similar to that used in previous impact assessments of MPAs in Scottish, English and UK waters.

3.4.25 In addition to the summary of anticipated ecosystem services benefits under the lower, intermediate and upper estimates, the assessments include four columns of information to clarify understanding of the qualitative changes in ecosystem services arising from the proposed management scenarios (see Tables 6a and 6b in the Site Reports in Appendix C):

- **Relevance**: Relating to the amount of ecosystem good or function arising from site;
- **Value weighting**: Categorisation of how valuable the amount of ecosystem good or function from the site is in providing benefits to human population;
- **Scale of benefits**: Consideration of actual potential to deliver benefits (for example considering location of benefits, delivery to human population, etc.);
- **Confidence**: Level of confidence in our current knowledge of all other categories (in other words, scale of benefit, level of improvement, etc.).

3.4.26 Based on the above categories, an overall level of each ecosystem service has been defined with its own confidence level. An overall level of total benefits has also been defined.

3.4.27 The parameters have been assigned a level for each service from a menu, defined as shown in Table 8.

3.4.28 The approach provides a qualitative summary of the expected ecosystem service benefits to ensure all relevant impacts are captured in the analysis.

Table 8. Definition of ecosystem service levels

Level	Definition
Nil	Not present/none
Minimal	Present at a very low level, unlikely to be large enough to make a noticeable impact on ecosystem services
Low	Present/detectable, may have a small noticeable impact on ecosystem services, but unlikely to cause a meaningful change to site's condition
Moderate	Present/detectable, noticeable incremental change to site's condition
High	Present/detectable order of magnitude impact on sites condition

Valuation of Ecosystem Services

3.4.29 There are limited valuation data for marine ecosystem services provided by MPA features. The National Ecosystem Assessment (NEA)[49] included a synthesis of data available up to 2010 for marine ecosystem services[50], and there have been subsequent reviews by Potts *et al.*[51] and Burdon *et al.*[52], expanding it to encompass additional features, including mobile features such as sandeel, basking shark, Risso's dolphin and minke whale.

3.4.30 To gauge the ecosystem services accruing from marine protected areas relevant valuation literature has been assessed including a recent review prepared as part of the NEA Follow-On project[53] Marine chapter and Turner and Schaafsma[54], there is data for market goods (e.g. fish, aggregates) that allow quantification and valuation of some flows of services. However, monetary valuation evidence for the value of protecting specific features and many ecosystem services are largely lacking. These data limitations impose significant constraints on the extent to which changes in ecosystem service provision can be quantified, and necessitate a largely qualitative analysis of ecosystem service impacts.

[49] UK National Ecosystem Assessment (2011) The UK National Ecosystem Assessment Technical Report. UNEP-WCMC, Cambridge.

[50] Austen, M., Malcolm, S., Frost, M., Hattam, C., Mangi, S., Stentiford, G., 2011. Marine. In: The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment. Cambridge: UNEP-WCMC.

[51] Potts T, Burdon D, Jackson E, Atkins J, Saunders J, Hastings E, Langmead O., 2014. Do marine protected areas deliver flows of ecosystem services to support human welfare? *Marine Policy* 44; 139–148.

[52] Burdon D, Potts T, Barbone C, Mandera L., 2017. The matrix revisited: A bird's-eye view of marine ecosystem service provision. *Marine Policy* 77; 78–89.

[53] UKNEA-FO (2014) Marine chapter. UNEP-WCMC, Cambridge.

[54] R.K. Turner and M. Schaafsma eds (2015) Coastal Zone Ecosystem Services, ch 6, Springer, Switzerland.

3.4.31 In addition, there are studies that use economic valuation techniques to assess the impacts of marine conservation measures, such as designation of and implementation of management measures in protected areas. There are a small number of such studies in the UK (e.g. McVittie and Moran[55]; Kenter *et al*,[56]), and some further information is available from the NEA Follow-on Project[57] and from eftec *et al.*[58].

3.5 Approach to assessing combined impacts

3.5.1 The combined assessment has considered the combined impact of the suite of new pMPAs.

3.5.2 For impacts to activities, the combined impact of the pMPAs has been estimated by summing the impacts for individual sites. In areas where there are concentrations of sites affecting a particular activity (as identified by the distributional analysis), further consideration has been given to the potential combined impact to describe qualitatively whether the combined impact might be larger or smaller than the sum of the individual impacts.

3.5.3 The scale of the sectors affected in Scotland has been used to provide context for assessing the significance of combined impacts to activities. Information on key sectors has been drawn (where available) from the Scottish Government's Economic Strategy, or from industry data. The significance of combined impacts has been assessed taking account of the scale of the impacts incurred by different sectors and the relative importance of each sector to the Scottish economy (now and in the future).

3.5.4 Information has also been collated on the total impact as a result of all MPAs, and current or planned renewable development to date, to provide context for the estimated impacts of the pMPAs on specific marine activities. Qualitative commentary is provided on whether this context might increase or decrease the significance of the impacts considered within this assessment.

3.5.5 For impacts to the public sector, a top-down approach has been used to assess costs to the public sector, using national assumptions, applied at site level. Adopting an additive approach therefore provides a reasonable estimate of the combined costs.

3.5.6 For the social analysis, the assessment of combined impacts has taken account of the distributional analysis to identify whether specific local communities or

[55] McVittie, A., & Moran, D., 2008. Determining monetary values for use and non-use goods and services: Marine Biodiversity–primary valuation. Final Report to Defra.

[56] Kenter, J.O., Bryce, R., Davies, A., Jobstvogt, N., Watson, V., Ranger, S., Solandt, J.L., Duncan, C., Christie, M., Crump, H., Irvine, K.N., Pinard, M. & Reed, M.S., (2013). The value of potential marine protected areas in the UK to divers and sea anglers. UNEP-WCMC, Cambridge, UK.

[57] UK National Ecosystem Assessment Follow-on, 2014. The UK National Ecosystem Assessment Follow-on: Synthesis of the Key Findings. UNEP-WCMC, LWEC, UK.

[58] eftec, ABPmer & University of Stirling, 2015. Valuing the UK Marine Environment – an Exploratory Study of Benthic Ecosystem Services. Project ME5106.

groups may be affected by multiple designations. Where there is the potential for multiple impacts, a qualitative assessment of the combined impacts on these communities or groups has been provided. Information has also been presented on the total impact as a result of all MPAs and current or planned renewable developments to date, to provide context for the estimated impacts of the pMPAs on specific marine activities. Qualitative commentary is provided on whether this context might increase or decrease the significance of the impacts considered within this assessment.

3.5.7 For the environmental impacts, part of the rationale for an ecologically-coherent network of MPAs is the concept that the value of the network is greater than the sum of its parts. However, scientific understanding of the relationships between individual sites and the network is limited and it is therefore difficult to provide any quantification of the combined benefits.

3.5.8 The selection of potential MPAs has been based on the Scottish MPA Selection Guidelines (Box 3, Marine Scotland *et al*[59]). These guidelines include a number of elements that relate to the wider benefits of a network, for example, replication supports resilience and connectivity supports linkages between marine ecosystems. These benefits have been reflected in Table 8 of Site Reports in Appendix C.

3.5.9 Value Transfer techniques have been used to apply existing valuation data for MPA networks to the proposals to designate the four pMPAs using a similar approach to that applied for the Nature Conservation MPA assessment[60] and drawing on further information published as part of the UK NEA Follow-On Project[61].

3.5.10 In addition to the individual site assessments, the ecosystem services impacts of the proposed management scenarios are considered collectively. This is due to the quantification and valuation of changes in individual services often not being possible due to lack of evidence, and because valuation evidence relates to sites (e.g. Kenter *et al.*[62]), or networks of sites (e.g. Brander *et al*,[63]).

Cumulative assessment

3.5.11 A cumulative assessment has given consideration to how the significance of these impacts might vary when taking account of the total impact as a result of

[59] Marine Scotland, JNCC and SNH, 2011. Marine Protected Areas in Scotland's Seas. Guidelines on the selection of MPAs. February, 2011.

[60] Marine Scotland, 2013. Planning Scotland's Seas: 2013 - The Scottish Marine Protected Area Project – Developing the Evidence Base tor Impact Assessments and the Sustainability Appraisal Final Report.

[61] UK National Ecosystem Assessment (2011) The UK National Ecosystem Assessment Technical Report. UNEP-WCMC, Cambridge.

[62] Kenter, J.O., Bryce, R., Davies, A., Jobstvogt, N., Watson, V., Ranger, S., Solandt, J.L., Duncan, C., Christie, M., Crump, H., Irvine, K.N., Pinard, M. & Reed, M.S., (2013). The value of potential marine protected areas in the UK to divers and sea anglers. UNEP-WCMC, Cambridge, UK.

[63] Brander *et al.,* 2015. The benefits to people of expanding Marine Protected Areas. IVM Institute for Environmental Studies.

all MPAs and current or planned renewable energy generation development to date, particularly where there is overlap between these and new pMPAs. This analysis has drawn on information contained within:

- the Scottish Nature Conservation MPA assessment[64];
- the socio-economic assessment for the short-term options for offshore wind farms[65];
- the socio-economic assessment for the draft plan for offshore wind, wave and tidal energy[66];
- monitoring of the impact of the implemented phase 1 measures in inshore MPAs[67]; and
- the SEIA of proposed phase 2 fisheries management measures in inshore MPAs[68].

3.5.12 This information helps to provide context for the additional impacts estimated to occur as a result of implementation of the four new pMPAs, particularly where these additional impacts will affect activities and communities that will or are experiencing impacts as a result of earlier decisions on MPAs or offshore renewables developments.

3.5.13 Information on the total impact on ecosystem services as a result of all marine environment protected areas has also been presented to provide context for the estimated impacts of the new pMPAs on specific marine activities and provide qualitative commentary on whether this context might increase or decrease the significance of the impacts considered within this assessment. The assessments for offshore renewables did not include an assessment of ecosystem service benefits of the proposals so this has not been included in the analysis. While offshore renewables developments have the potential to lead to changes in the level of ecosystem services provided by the marine environment, these changes would be expected to be more minor than those associated with MPA designations which specifically seek to protect more important national biodiversity and geodiversity interests.

[64] Marine Scotland, 2013. Planning Scotland's Seas: 2013 - The Scottish Marine Protected Area Project – Developing the Evidence Base tor Impact Assessments and the Sustainability Appraisal Final Report.

[65] Marine Scotland, 2011. Blue Seas – Green Energy: A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters. Part A – The Plan.

[66] Marine Scotland, 2013. Planning Scotland's Seas: Sectoral Marine Plans for Offshore Wind, Wave and Tidal Energy in Scottish Waters - Consultation Draft, July 2013.

[67] Marine Scotland Science, 2017. Scotland Marine Protected Areas Socioeconomic Monitoring. 2016 Report. Marine Analytical Unit, Marine Scotland Science, Scottish Government. Available online at http://www.gov.scot/Resource/0051/00514589.pdf. Accessed 19 April 2018.

[68] Marine Scotland, 2018. Proposed Inshore MPA/SAC Fisheries Management Measures – Phase 2. Socio-Economic Impact Assessment. October 2018. Report prepared by ABPmer & eftec for the Scottish Government.

4 Impacts to Activities

4.1 Introduction

4.1.1 This section summarises the estimated costs and benefits associated with the designation of the four pMPAs for each sector. Quantified cost estimates are presented in tables for each sector. Where impacts are expected to affect a sector's output, the impact on GVA and employment is also provided. Impacts that are anticipated, but for which cost estimates were not possible, are described qualitatively.

4.2 Aquaculture – Finfish

4.2.1 Potential quantified cost impacts[69] to the finfish aquaculture sector are summarised in Table 9. The costs are primarily associated with additional assessments required to take account of the pMPA protected features in the lower estimate, and replacement of acoustic deterrent devices in the intermediate and upper estimates. It has been assumed that any additional survey costs associated with the Inner Hebrides Carbonate Production Area in Sea of Hebrides pMPA would be required as part of the protection of Priority Marine Features and hence are not included in this assessment.

Table 9 Potential cost impacts to the finfish aquaculture sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	9	71	107
Sea of the Hebrides pMPA	29	198	300
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	0	0	0
Total	39	269	407

4.2.2 The total estimated cost impacts vary across the three scenarios, with the lower scenario estimated cost approximately 10% of the intermediate estimate. The bulk of the cost in the intermediate and upper scenarios is driven by proposed management scenarios to replace ADDs with either cetacean-friendly ADDs (intermediate) or anti-predator nets (upper). Current sites which overlap with similar management measures proposed for the Inner Hebrides and the Minches SAC have been excluded, as costs have been considered under the applicable study for the SAC. The combined cost of £0.269m (Intermediate

[69] Note, for all tables of results, totals may not sum due to rounding.

estimate, present value over 20 years (2019 to 2038) at 2019 prices) is minor relative to the annual turnover of the industry (approximately £765m in 2016[70]). However, this cost is relatively high per aquaculture site (approximately 3% of Scottish aquaculture sites are within SOH or NEL) and it is noted that salmon farming is an international industry subject to strong competition and any additional costs could affect both individual sites and the Scottish industry's competitiveness.

4.2.3 It has not been possible to quantify the impact of the potential costs on investor confidence or the impact of any delays in the consenting process as a result of the designations. These cost impacts have the potential to be significant for the sector under the intermediate and upper scenarios.

4.3 Aquaculture – Shellfish

4.3.1 Potential quantified cost impacts to the shellfish aquaculture sector are summarised in Table 10. The costs are primarily associated with additional assessments required to take account of the pMPA protected features. It has been assumed that any additional survey costs associated with the Inner Hebrides Carbonate Production Area in Sea of Hebrides pMPA would be required as part of the protection of Priority Marine Features and hence are not included in this assessment.

Table 10 Potential cost impacts to the shellfish aquaculture sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	9	9	9
Sea of the Hebrides pMPA	66	66	66
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	0	0	0
Total	**76**	**76**	**76**

4.3.2 The total estimated cost impacts are the same for all three scenarios. The combined cost of £0.076m (Intermediate estimate, present value over 20 years (2019 to 2038) at 2019 prices) is minor relative to the annual turnover of the industry (approximately £12.4m in 2017[71]).

4.3.3 It has not been possible to quantify the impact of the potential costs on investor confidence or the impact of any delays in the consenting process as a result of

[70] Marine Scotland Science, 2017. Scottish fish farm production survey 2016. Available online at: https://www.gov.scot/Resource/0052/00524803.pdf

[71] Marine Scotland Science, 2018. Scottish Shellfish Farm Production Survey 2017. Available online at: https://beta.gov.scot/publications/scottish-shellfish-farm-production-survey-2017-9781788518703/.

the designations. These cost impacts are not considered likely to be significant for the sector.

4.4 Carbon Capture and Storage

4.4.1 Potential quantified cost impacts to the carbon capture and storage sector are summarised in Table 11. There is currently only one proposed carbon capture and storage project in Scottish waters — the ACT Acorn CCS project which will export carbon dioxide from via existing pipeline infrastructure for long-term storage in the Captain Sandstone saline aquifer 100km offshore. The proposed pipeline infrastructure for the ACT project would run through the STR pMPA (see Appendix A). Minor additional costs may be incurred under all scenarios in providing additional information to inform the assessment for the Marine Licence and other planning permissions to ensure that protected features are adequately protected during construction activity.

4.4.2 There is potential for significant costs under the upper scenario, based on the potential for restricting survey effort to the winter (November to April). This is likely to have a knock on effect on costs by increasing the number of days of weather downtime for each survey.

4.4.3 It is possible that additional carbon capture and storage projects may come forward for consenting within the impact assessment period. Depending on the location and nature of such development this may mean that the quantified cost estimate will be an underestimate of the costs likely to be incurred over the period of the impact assessment.

4.4.4 There is also potential for the carbon capture and storage sector to experience other cost impacts which have not been quantified in this assessment. These include cost impacts associated with any delays in consenting processes or deterrent to investment. These cost impacts have the potential to be greater than the quantified cost impacts identified in this assessment.

Table 11 Potential cost impacts to the carbon capture and storage sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	0	0	0
Sea of the Hebrides pMPA	0	0	0
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	5	5	554
Total	**5**	**5**	**554**

4.4.5 The total estimated costs are similar for the lower and intermediate scenario, based on additional assessment required for the single identified project. The upper scenario, however, is considerably higher (£554,000) due to the impact of potential weather delays on survey activities during the winter period. This

figure is based on an approximate doubling of the time required for survey, and could potentially be higher or lower depending on the actual weather conditions experienced.

4.5 Coastal Protection and Flood Defence

4.5.1 Potential quantified cost impacts to the coastal protection and flood defence sector are summarised in Table 10. The costs are primarily associated with additional assessments required to take account of the pMPA protected features.

Table 12 Potential cost impacts to the coastal protection and flood defence sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	16	16	16
Sea of the Hebrides pMPA	16	16	16
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	16	16	16
Total	**49**	**49**	**49**

4.5.2 The total estimated cost impacts are the same for all three scenarios. The combined cost of £0.049m (Intermediate estimate, present value over 20 years (2019 to 2038) at 2019 prices) is considered to be negligible, and unlikely to impact on maintenance or development of coastal protection or flood defence assets in or near the pMPAs.

4.6 Commercial Fisheries

4.6.1 The proposed management scenarios could result in impacts on GVA as a result of a reduction in output (loss in value of landings). Potential impacts to GVA for the commercial fisheries sector are summarised in Table 13. The equivalent figures expressed in terms of potential impacts on the annual value of landings affected are presented in Table 14. These impacts could arise as a result of reduced landings from areas in pMPAs where fishing effort would be restricted under the assessed management options for each site.

4.6.2 The total cost for all pMPAs of £2.1 million over 20 years (Table 13, intermediate scenario, present value of direct and indirect GVA over 20 years at 2019 prices) is relatively small compared to the GVA of the fishing sector (£296 million annually, 2016[72]). This equates to an annual average value for

[72] Marine Scotland, 2018. Scotland's Marine Economic Statistics. Published by The Scottish Government, October 2018. 77 pages. Available at: https://www.gov.scot/Resource/0054/00542012.pdf. Accessed 22/10/18.

affected landings of £266,000 per year (Table 14), compared to £557 million[73] landings for the Scottish fishing sector as a whole in 2016. The local impacts in relation to value of landings taken from inshore regions, and in relation to the value of landings affected by Home Port and Port of Landing, are considered in section 6.

4.6.3 The estimated impacts are zero under the lower scenario and minor to moderate under the intermediate and upper scenarios. Under the intermediate and upper estimates, the impacts are mainly related to Southern Trench pMPA, where there is potential for a large impact on demersal trawls operating on burrowed mud (i.e. likely to be *Nephrops* trawls), particularly the over-12m sector, due to the restriction in mobile bottom gear effort across burrowed mud, which is an important *Nephrops* fishing ground.

4.6.4 Impacts under the intermediate and upper estimates are mainly in the Moray and Buchan regions, arising from Southern Trench.

Table 13 Potential GVA impacts to the commercial fisheries sector (direct effect and the combined direct and indirect effect) (present value of total GVA impact, £000s)

Site	Estimate (Direct GVA)			Estimate (Direct + Indirect GVA)		
	Lower	Inter-mediate	Upper	Lower	Inter-mediate	Upper
North-East Lewis pMPA	0	N.D.	N.D.	0	N.D.	N.D.
Sea of the Hebrides pMPA	0	16	25	0	23	36
Shiant East Bank pMPA	0	177	296	0	257	429
Southern Trench pMPA	0	1,288	2,570	0	1,864	3,721
Total	**0**	**1,481**	**2,892**	**0**	**2,144**	**4,187**
N.D. = Value cannot be disclosed. Where data represent 5 or fewer individuals/vessels/companies, their value cannot be disclosed for data protection reasons.						

[73] Scottish Government, 2017. Scottish Sea Fisheries Statistics 2016. Available at: https://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/PubFisheries. Accessed 22/10/2018.

Table 14 Potential annual average loss in value of landings for the commercial fisheries sector (£000s, 2019 prices)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	0	N.D.	N.D.
Sea of the Hebrides pMPA	0	2	4
Shiant East Bank pMPA	0	30	50
Southern Trench pMPA	0	234	467
Total	**0**	**266**	**521**
N.D. = Value cannot be disclosed. Where data represent fewer than 5 individuals/vessels/companies, their value cannot be disclosed for data protection reasons.			

4.6.5 Potential direct and indirect impacts on employment for the commercial fisheries sector are summarised in Table 15. These impacts arise as a result of the reduced landings and GVA impacts discussed above, which may have knock-on effects on employment in the catching sector (direct) and the upstream supply chain (indirect).

4.6.6 The total direct and indirect employment impact is between zero and 8 full-time equivalents (FTE) under the upper scenario, and 4 FTEs under the intermediate estimate.

4.6.7 Impacts mainly arise from the Moray and Buchan regions (3.5 FTE under the intermediate estimate) from the Southern Trench pMPA, followed by North Minch (0.5 FTE) from the Shiant East Bank pMPA. Under the upper scenario, the impacts arise from the same regions, with 0.1 FTE impact also arising from Sea of the Hebrides pMPA, which straddles both North Minch and South Minch regions.

Table 15 Potential direct and indirect employment impacts to the commercial fisheries sector (full-time equivalents)

Site	Estimate (Direct and Indirect FTEs)			Estimate (Direct, Indirect and Induced FTEs)		
	Lower	Intermediate	Upper	Lower	Intermediate	Upper
North-East Lewis pMPA	0.0	N.D.	N.D.	0.0	N.D.	N.D.
Sea of the Hebrides pMPA	0.0	0.0	0.1	0.0	0.1	0.1
Shiant East Bank pMPA	0.0	0.5	0.8	0.0	0.5	0.8
Southern Trench pMPA	0.0	3.5	7.1	0.0	3.8	7.6
Total	**0.0**	**4.0**	**7.9**	**0.0**	**4.4**	**8.5**
N.D. = Value cannot be disclosed. Where data represent fewer than 5 individuals/vessels/companies, their value cannot be disclosed for data protection reasons.						

4.7 Energy Generation

4.7.1 Potential quantified cost impacts to the energy generation sector are summarised in Table 16. The potential cost impacts identified relate exclusively to the offshore wind sector. The only identified cost impact relates to seasonal restrictions on future survey of the export cable for the Moray East offshore wind farm.

4.7.2 It should be noted that further offshore renewables development is likely to come forward for licensing during the period of the impact assessment, including offshore wind, wave and tidal developments. However, the location and nature of such development is uncertain, with draft plan option areas yet to be defined for offshore wind, and the development of tidal and wave energy in Scotland has been slow to begin. It has therefore not been possible to make a meaningful assessment of potential impacts. This means that the cost estimate may be an underestimate of the costs likely to be incurred over the period of the impact assessment.

4.7.3 It is noted, however, that the potential restriction on development within the shark awareness zones within SOH, overlaps with a draft plan option area for wave energy identified in the Sectoral Marine Plan for Wave Energy. While there are no current plans for development, this could be considered an opportunity cost for the industry should development of the area be prevented.

4.7.4 There is also potential for the offshore renewables sector to experience other cost impacts which have not been quantified in this assessment. These include cost impacts associated with any delays in the consenting processes or deterrent to investment. The extent to which these impacts might arise as a result of the pMPA designations is unknown.

Table 16 Potential cost impacts to the energy generation sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	0	0	0
Sea of the Hebrides pMPA	0	0	0
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	0	0	548
Total	**0**	**0**	**548**

4.7.5 The only quantified cost arising from the designation and management of the pMPAs to the energy generation sector are related to seasonal restrictions on the survey of submarine export cables within the STR pMPA. This cost (£548,000) is minor relative to the capital expenditure associated with the

construction, operation and maintenance of the offshore wind farm which has been estimated to be around £6bn[74].

4.8 Military Activities

4.8.1 Potential cost impacts to military activities at a national level are summarised in Table 17.

4.8.2 The costs are estimated to be the same in each scenario. The costs relate to the need for the Ministry of Defence (MoD) to amend and update its Marine Environment and Sustainability Assessment Tool (MESAT) (and other MoD environmental tools) together with subsequent costs to maintain and comply with these updates. The assessment has been made at a national level because it is not possible to assign these costs to individual site proposals.

Table 17 Potential cost impacts to military activities (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
National assessment	195	195	195
Total	**195**	**195**	**195**

4.9 Oil and Gas

4.9.1 Potential quantified cost impacts to the oil and gas sector are summarised in Table 18. The cost estimates have only identified any cost to the oil and gas industry in the upper scenario in STR, based on seasonal restrictions for survey of current pipeline infrastructure, originating from St Fergus and Peterhead.

4.9.2 There is also potential for the oil and gas sector to experience other cost impacts which have not been quantified in this assessment. These include cost impacts associated with any delays in consenting processes or deterrent to investment, and additional costs associated with any future pipeline construction and subsequent survey in the pMPAs.

[74] BVG Associates, 2011. Wave and tidal energy in the Pentland Firth and Orkney waters: How the projects could be built. A report commissioned by The Crown Estate and prepared by BVG Associates. May 2011.

Table 18 Potential cost impacts to the oil and gas sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	0	0	0
Sea of the Hebrides pMPA	0	0	0
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	0	0	7,502
Total	**0**	**0**	**7,502**

4.10 Ports and Harbours

4.10.1 Potential cost impacts to the ports and harbours sector are summarised in Table 19. The quantified costs are primarily associated with additional assessment of marine licence applications for port development or dredge material disposal licence renewals together with possible requirements for additional monitoring to test environmental impact assessment predictions in relation to major port development proposals. Some minor costs may also be incurred in developing and distributing notices to mariners to disseminate information regarding speed restrictions in shark awareness zones within SOH in the upper scenario.

4.10.2 There is also potential for ports to experience other cost impacts which have not been quantified in this assessment. These include the potential for consequential impacts to ports and harbours revenues associated with reductions in activity by other marine sectors, for example, commercial fisheries and energy generation, as well as the impact of any delays in consenting processes or deterrent to investment. The extent to which such impacts might arise is very uncertain and it has therefore not been possible to quantify such costs within the impact assessment.

Table 19 Potential cost impacts to the ports and harbour sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	27	27	27
Sea of the Hebrides pMPA	59	59	62
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	92	92	92
Total	**179**	**179**	**182**

4.10.3 The total estimated cost impacts are similar for all three scenarios. The combined cost of £0.18m (Intermediate estimate, present value over 20 years

(2019 to 2038) at 2019 prices) is minor relative to the annual turnover of the industry (approximately £598m in 2015[75]).

4.11 Power Interconnectors and Transmission Lines

4.11.1 Potential quantified cost impacts to the power interconnectors and transmission lines sector are summarised in Table 20. Cost impacts are only anticipated to occur in relation to the NEL and STR pMPAs. The potential costs are associated with the future assessment and subsequent construction and monitoring of the Western Isles HVDC (NEL) and the construction and monitoring of the Caithness to Moray transmission reinforcement (STR).

4.11.2 There is also potential for the power interconnectors and transmission lines sector to experience other cost impacts which have not been quantified in this assessment. These include cost impacts associated with future as yet unidentified power cable projects, the impact of any delays in consenting processes or deterrent to investment. These cost impacts have the potential to be greater than the quantified cost impacts identified in this assessment.

4.11.3 The current route for the Western Isles HVDC has been reviewed and is assumed not to transect SEB. Therefore there are assumed to be no costs derived from re-routing the cable to avoid northern sea fan and sponge communities.

Table 20 Potential cost impacts to the power interconnectors and transmission lines sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	6	6	478
Sea of the Hebrides pMPA	0	0	0
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	0	0	588
Total	**6**	**6**	**1,066**

4.11.4 The potential costs associated with the low and intermediate scenarios are limited to assessment of the Western Isles HVDC route in NEL and are considered negligible. In the upper scenario, however, the combined costs over the 20 year assessment period of £1.07 million is based on the seasonal restriction on survey activities to the winter months, and the subsequent likely additional weather downtime associated with the requirement to survey the cable routes regularly.

[75] Marine Scotland Science, 2018. Scottish Shellfish Farm Production Survey 2017. Available online at: https://beta.gov.scot/publications/scottish-shellfish-farm-production-survey-2017-9781788518703/.

4.12 Recreational Boating

4.12.1 Potential quantified cost impacts to the recreational boating sector are summarised in Table 21. There are no predicted costs under the low and intermediate scenarios and only minimal costs under the upper scenario. This minor cost relates to a possible need for the Royal Yachting Association Scotland (RYA) to disseminate information to members regarding potential speed restrictions in the shark awareness zones. It has been assumed that implementation of the speed restrictions will not impose any significant costs on recreational boaters or their supply chains.

Table 21 Potential cost impacts to the recreational boating sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	0	0	0
Sea of the Hebrides pMPA	0	0	1
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	0	0	0
Total	**0**	**0**	**1**

4.13 Shipping

4.13.1 Potential cost impacts to the shipping sector are summarised in Table 22. Cost impacts are only anticipated to occur in relation to the Sea of Hebrides MPA.

4.13.2 There are no predicted costs under the lower and intermediate scenarios. Within the Sea of Hebrides pMPA minimal cost impacts (£1,000) may arise under the upper scenarios associated with a requirement for the UKHO to update nautical charts and disseminate information regarding the potential shark awareness zones.

4.13.3 Due to the small size of the shark awareness zones and the exclusion of ferry traffic from the restrictions there is assumed to be no cost to the shipping industry associated with implementation of the speed restrictions.

Table 22 Potential cost impacts to the shipping sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	0	0	0
Sea of the Hebrides pMPA	0	0	1
Shiant East Bank pMPA	0	0	0
Southern Trench pMPA	0	0	0
Total	**0**	**0**	**1**

4.14 Telecom Cables

4.14.1 Potential quantified cost impacts to the telecom cables sector are summarised in Table 23. The identified costs relate to potential replacement of existing telecom cables within the period of IA and the need for assessment of any impacts to protected features (within 12nm of the territorial baseline), where cable routes transect MPA habitat features. For one site, Shiant East Bank, it has been assumed that it may be necessary to route the cable around specific habitat features under the upper scenario.

4.14.2 There is also potential for the telecom cables sector to experience other cost impacts which have not been quantified in this assessment. These include cost impacts associated with future as yet unidentified telecom cable projects, the impact of any delays in consenting processes or deterrent to investment. These cost impacts have the potential to be greater than the quantified cost impacts identified in this assessment.

Table 23 Potential cost impacts to the telecom cables sector (present value of total costs over 20 years, £000s)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	4	4	4
Sea of the Hebrides pMPA	4	4	4
Shiant East Bank pMPA	4	4	319
Southern Trench pMPA	4	4	4
Total	**16**	**16**	**331**

4.14.3 The cost associated with additional assessment is applicable across all three scenarios, and therefore the lower and intermediate scenarios have the same cost estimate (£16,000). Potentially larger costs could be incurred in the upper

scenario for Shiant East Bank MPA if telecom cables needed to be re-routed to avoid sensitive habitat features, and therefore the combined cost over 20 years for the upper scenario is £0.33 million.

4.15 Tourism

4.15.1 There are no costs associated with the implementation of management scenarios to the tourism industry, as the industry is assumed to currently follow best practice measures, and the restriction of vessel speeds in shark awareness zones is assumed to be integrated with no associated cost to industry, particularly where tourism activities are actively aimed at viewing basking sharks as a target species.

4.16 Water Sports

4.16.1 There are no costs associated with the implementation of management scenarios to the water sports sector, as the sector is assumed to currently follow best practice measures, and the restriction of vessel speeds in shark awareness zones is assumed to be integrated with no associated cost.

5 Impacts to the Public Sector

5.1.1 Estimated costs to the public sector are shown in Table 24 and Table 25. Potential future monitoring costs comprise the majority of the total public-sector costs, spread across all pMPAs. Additional costs may be associated with the preparation of Management Schemes and in determining and advising upon licence applications within or near to the proposed sites.

5.1.2 Compliance and enforcement for fisheries, and promotion of public understanding are considered to be part of existing workstreams and extra costs as a result of the MPAs will not apply.

5.1.3 Site monitoring costs are the greatest public sector cost. In relation to individual sites, those sites supporting cetacean or basking shark features generally have higher costs associated with them owing to the greater site monitoring costs for these features.

Table 24 Potential cost impacts to the public sector by activity (present value of total costs over 20 years, £000s)

Activity	Quantified Cost Impact		
	Lower Estimate	Intermediate Estimate	Upper Estimate
Preparation of marine management schemes	79	79	79
Preparation of statutory instruments	0	16	16
Development of voluntary measures	16	16	16
Site monitoring	1,144	1,144	1,144
Compliance and enforcement	0	0	0
Promotion of public understanding	0	0	0
Regulatory and advisory costs associated with licensing decisions	37	37	37
Total	**1,277**	**1,293**	**1,293**

Table 25 Potential cost impacts to the public sector by site (present value of total costs over 20 years, £000s)

Site Name	Quantified Cost Impact		
	Lower Estimate	Intermediate Estimate	Upper Estimate
Sea of Hebrides	285	289	289
Shiant East Bank	146	150	150
North-east Lewis	275	279	279
Southern Trench	421	425	425
National cost not assigned to individual sites: ▪ Setting up site monitoring scheme	150	150	150
Total	**1,277**	**1,293**	**1,293**

5.1.4 The above costs have been estimated on the assumption that Marine Scotland and SNH are primarily responsible for management of the sites. There may be opportunities for local authorities to be more involved in the management of some sites, particularly the more inshore sites. While this would change the distribution of costs, it is unlikely to result in a significant reduction in management costs. However, greater local involvement in the management of the site may increase the levels of compliance with the management scheme and increase the environmental benefits.

5.1.5 The monitoring proposals for the MPAs with cetacean and basking shark features already envisage a partnership approach with local academic and environmental organisations that have an interest in such monitoring. If there is stronger local management of sites, this may increase local commitment to monitoring programmes although this may not lead to any reduction in the requirement for public funding of such programmes.

6 Distribution of Economic Costs and Consequent Social Impacts

6.1 Overview

6.1.1 The designation of the entire suite of proposed pMPAs is estimated to:

- Reduce the average annual value of output landed by the commercial fisheries sector by between £0m and £0.5m;
- Reduce GVA (direct and indirect) over the 20 year assessment period by £0 to £4.2 million (present value); and
- Reduce the average (mean number of jobs, direct, indirect and induced) by between 0 FTEs and 9 FTEs.

6.1.2 The range reflects the different management options and assumptions assessed across the estimates.

6.1.3 The higher end of these ranges are from the upper scenarios. They represent stronger management options and a worst-case assumption that all economic activity is lost rather than being displaced to alternative fishing grounds. The lower end represents the lower scenario, with risks to designated features being addressed through best practice approaches, which are assumed to not imply a cost to the industry.

6.1.4 In addition to the impact on the commercial fisheries sector, reductions in the quantity of seafish landed at Scottish landing ports, would reduce the supply of locally-landed catch to fish processing facilities, and to the hotel/restaurant, retail and wholesale trades. The distributional analysis therefore considers how the impacts on both sectors (commercial fisheries and fish processing) are likely to be distributed across different areas of Scotland and specific groups of people, and assesses the likely significance of these impacts.

6.1.5 The distributional analysis presented in this section considers the distribution of the potential economic (and hence social) costs of all the proposed management scenarios. Impacts have been calculated by applying national multipliers[76] at the site level and regional/ port level to estimate the economic impacts of management scenarios at sites and by region/port. Local and regional multipliers are not available and hence the application of national multipliers may overestimate or underestimate the size and geographical distribution of impacts. A distributional analysis has also been conducted for each site and is presented in the Site Reports in Appendix C.

6.1.6 The different aspects assessed as part of the social impact analysis for each site are:

[76] Source: http://www.gov.scot/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2014Latest

- The area of social impact associated with the economic impacts identified; Whether any mitigation effects are planned/necessary; and the overall significance of social impacts (all in Table 4a in Appendix C);
- For the fishing sector, Table 4b in Appendix C considers the main vessel sizes, gear types, regions, home ports and ports of landings, and whether ports are rural/urban and mainland or island.
- In Table 4c in Appendix C, the distribution of social impacts is considered by age, income, social group and gender.

6.1.7 The key results of the sites' distributional analysis are summarised in Table 26 and Table 27. For some aspects, the distribution of costs (e.g. across different Scottish regions and ports, and categories of vessel) has been assessed quantitatively. For other aspects (i.e. age, gender, income and social groups), the analysis indicates whether management scenarios at sites are likely to impact on these groups, and if so, whether the impact is anticipated to be minimal, negative, or significantly negative.

Table 26. Distribution of quantified economic costs for commercial fisheries and fish processors (Intermediate estimate) — Location, age, gender

Sector/ Impact	Location			Age			Gender	
	Regions	Port (s)	Rural, Urban, Coastal or Island	Children	Working Age	Pensionable Age	Male	Female
Commercial Fisheries Reduction in landed value, GVA and employment	Regional share of total reductions in landings: Buchan: 2% Clyde: 3% Clyde and South Minch: 1% Forth: 0.2% Moray: 81% Northern Isles: 0.3% North Minch: 7% South Minch: 4%	Largest absolute employment impacts for intermediate estimate in: Fraserburgh: 3 FTEs Largest relative employment impact (based on landings affected compared to total landings of home port) under Intermediate Estimate: Fraserburgh: 0.6%	xx Impacts concentrated in coastal areas; urban in North-East.	x Potentially significant negative effect if parent loses job/ becomes unemployed	xx	x Potential negative effect if retirees own affected vessels or live in households affected by unemployment	xx 3 FTE job losses	xx Potentially significant negative effect if member of household loses job/ becomes unemployed
Fish Processors Reduction in local landings at landing ports	xx North-east region most significantly affected	In all ports, affected landings represent a very low proportion (up to 0.8%) of total landings to port, or have very low value.	xx Impacts concentrated in coastal areas; urban in North-East	x	xx	0	x 60% of processors male	x 40% of processors female
Impacts: xxx: significant negative effect; xx: possible negative effects; x: minimal negative effect, if any; 0: no noticeable effect expected.								

Table 27. Distribution of quantified economic costs for commercial fisheries and fish processors (Intermediate estimate unless otherwise specified) — Fishing groups, income groups and social groups

Sector/ Impact	Fishing Groups		Income Group			Social Groups		
	Vessel Category <12 m, >12 m	Gear Types/Sector	10% Most Deprived	Middle 80%	10% Most Affluent	Crofters	Ethnic Minorities	With Disability or Long-Term Sick
Commercial fisheries Reduction in landed value, GVA and employment	Under lower estimate – no impacts Under intermediate and upper estimate – main impacts on >12 m vessels	Main gear types affected for vessels are demersal trawlers. No impact on pelagic vessels	xx Possible negative impact on 10% most deprived	xx Possible negative impact on middle income group	x Information only available on average incomes, not the distribution of income. Not clear, therefore, whether this group will be affected	0	No breakdown of fisherman employment by social group	0 No employment data but unlikely to be employed in fisheries
Fish Processors Reduction in local landings at landing ports		x Impacts are < 1% of landings at any port.	x	x	0	0	No breakdown of fish processing employment data available by social group	No breakdown of fish processing employment data available by social group
Impacts: xxx: significant negative effect; xx: possible negative effects; x: minimal negative effect, if any; 0: no noticeable effect expected								

6.2 Distribution of Economic Costs – Location

6.2.1 The following assessment is mainly based on the intermediate estimate. Significant impacts under the upper estimate are also highlighted, as they represent a worst-case prediction of impacts for decision-makers to be aware of.

6.2.2 Table 28 presents the annual loss of landings affected by region and home port of the vessels affected, providing an indication of where employment impacts may fall. It covers all sizes of vessels – those greater than 12 m and less than 12 m. As shown in Table 31 below, over 90% of the impacts are on over-12m vessels in both the intermediate and upper scenarios. There are no estimated impacts for either over-12 m or under-12 m vessels in the lower scenario.

6.2.3 The analysis presented below therefore captures the key impacts, although it is recognised that the distribution of impacts across ports may be different between larger-scale and smaller-scale vessels.

6.2.4 Table 28 and Table 29 show that:

- The expected costs of the proposed management scenarios are predominantly on the East Coast (in the Moray region). It is estimated that over 70% of the total landings lost in Scotland due to all combined management scenarios across the sites would be lost from Fraserburgh. Losses at Stornoway, Buckie, Mallaig, Campbeltown and Ullapool would be between 3-4% of the landings lost in Scotland due to all management scenarios. Note these totals are not the percentage of landings lost at the respective ports, which are described in Table 30.
- A similar pattern of impacts arises under the upper estimate, but with a greater proportion of impacts at Fraserburgh (nearly 80%), and lower proportions at Campbeltown and Ullapool (2%).

6.2.5 While these ports may bear the greater proportion of the total effects across Scotland, the most significant impacts depend on their scale relative to the size of the affected port, as shown in Table 30. In the intermediate estimate the most significant impacts would be felt where landings account for a greater proportion of the total activity at a port. The impact on landings is small across all ports under the intermediate estimate, with Fraserburgh having the highest impact (0.6% of total landings by vessels from that port). Ayr, Buckie, Stornoway, Portree, Campbeltown and Mallaig all have impacts below 0.5% of total landings to port.

6.2.6 The employment impacts vary across these ports, although are generally low as a percentage of total employment. They are most significant in Fraserburgh, affecting 0.5% of employment at the port. There are also potential effects at Buckie, Mallaig, Stornoway and Ullapool (0.1%). The impacts per port are

calculated as a proportion of total landings per port, provided by Marine Scotland.

6.2.7 Table 30 shows that the value of landings lost as a result of the proposed management scenarios represents a very small proportion of total landings by home port for the large majority of Scotland's districts and ports affected for the intermediate and upper estimates.

6.2.8 The largest impacts under the upper estimate affect the same ports as mentioned above. The scale of job losses at Fraserburgh is potentially significant, and is estimated to be 3 to 6 jobs at risk under the intermediate and upper estimates, at worst a 1% reduction in the local fishing workforce. This worst-case upper estimate could result in social impacts for the local community.

Table 28. Annual average value (£000) of landings affected by region and home port of vessels affected, 2019 prices

Home Fishing Region/Port		Scenarios		
		Lower	Intermediate	Upper
		Total value of landings affected at port		
Buchan	Aberdeen	0	N.D.	N.D.
	Peterhead	0	6	13
	Buchan total:	0	6	13
Clyde	Ayr	0	0	1
	Campbeltown	0	7	9
	Clyde total:	**0**	**8**	**10**
Clyde and South Minch	Oban	0	1	2
	Clyde and South Minch total:	**0**	**1**	**2**
Forth	Eyemouth	0	0	1
	Pittenweem	0	N.D.	N.D.
	Forth total:	**0**	**0**	**1**
Moray	Buckie	0	9	18
	Fraserburgh	0	206	412
	Moray total:	**0**	**215**	**430**
North Minch	Kinlochbervie	0	1	1
	Lochinver	0	N.D.	N.D.
	Stornoway	0	10	20
	Ullapool	0	7	12
	North Minch total:	**0**	**18**	**33**
Northern Isles	Kirkwall	0	0	1
	Scrabster	0	0	0
	Lerwick	0	N.D.	N.D.
	Northern Isles total:	**0**	**1**	**1**
South Minch	Mallaig	0	9	17
	Portree	0	3	5
	South Minch total:	**0**	**12**	**22**
Other UK Ports		0	4	8
TOTAL		**0**	**266**	**521**

N.D. = Value cannot be disclosed. Where data represent fewer than 5 individuals/vessels/companies, their value cannot be disclosed for data protection reasons.

Table 29. Distribution of total landings affected across all sites, by region and home port of vessels

Home Fishing Region/Port		Scenarios		
		Lower	Intermediate	Upper
		As % of total value of landings affected across all ports		
Buchan	Aberdeen		N.D	N.D.
	Peterhead		2%	2%
	Buchan total:		**2%**	**2%**
Clyde	Ayr		0%	0%
	Campbeltown		3%	2%
	Clyde total:		**3%**	**2%**
Clyde and South Minch	Oban		1%	0%
	Clyde and South Minch total:		**1%**	**0%**
Forth	Eyemouth		0%	0%
	Pittenweem		N.D.	N.D.
	Forth total:		**0%**	**0%**
Moray	Buckie		3%	3%
	Fraserburgh		77%	79%
	Moray total:		**81%**	**82%**
North Minch	Kinlochbervie		0%	0%
	Lochinver		N.D.	N.D.
	Stornoway		4%	4%
	Ullapool		3%	2%
	North Minch total:		**7%**	**6%**
Northern Isles	Kirkwall		0%	0%
	Scrabster		0%	0%
	Lerwick		N.D.	N.D.
	Northern Isles total:		**0%**	**0%**
South Minch	Mallaig		3%	3%
	Portree		1%	1%
	South Minch total:		**4%**	**4%**
Other UK Ports			2%	2%
TOTAL		**0%**	**100%**	**100%**

N.D. = Value cannot be disclosed. Where data represent fewer than 5 individuals/vessels/companies, their value cannot be disclosed for data protection reasons.

Table 30. Landings affected as a percentage of total landings and job losses as a percentage of the total number of fishermen employed, by home district/port

Home District / Port	Scenarios								
	Lower			Intermediate			Upper		
	Affected landings as % of total landings to port	Estimated reduction in employment	In employment as % of total employed in	Affected landings as % of total landings to port	Estimated reduction in employment	In employment as % of total employed in	Affected landings as % of total landings to port	Estimated reduction in employment	In employment as % of total employed in
Aberdeen	N.D.	N.D.	0.0%	N.D.	N.D.	0.0%	N.D.	N.D.	0.0%
Ayr	0.0%	0.0	0.0%	0.4%	0.0	0.0%	0.7%	0.0	0.0%
Buckie	0.0%	0.0	0.0%	0.3%	0.1	0.1%	0.6%	0.3	0.3%
Campbeltown	N.D.	N.D.	0.0%	N.D.	N.D.	0.0%	N.D.	N.D.	0.1%
Eyemouth	N.D.	N.D.	0.0%	N.D.	N.D.	0.0%	N.D.	N.D.	0.0%
Fraserburgh	0.0%	0.0	0.0%	0.6%	3.1	0.5%	1.1%	6.2	1.0%
Kinlochbervie	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.1%
Kirkwall	0.0%	0.0		0.0%	0.0		0.0%	0.0	
Lerwick	N.D.	N.D.		N.D.	N.D.		N.D.	N.D.	
Lochinver	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%
Mallaig	0.0%	0.0	0.0%	0.1%	0.1	0.1%	0.2%	0.3	0.3%
Oban	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%
Peterhead	0.0%	0.0	0.0%	0.0%	0.1	0.0%	0.0%	0.2	0.1%
Pittenweem	N.D.	N.D.		N.D.	N.D.		N.D.	N.D.	
Portree	0.0%	0.0	0.0%	0.2%	0.0	0.0%	0.3%	0.1	0.1%
Scrabster	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%
Stornoway	0.0%	0.0	0.0%	0.3%	0.2	0.1%	0.6%	0.3	0.1%
Ullapool	0.0%	0.0	0.0%	0.0%	0.1	0.1%	0.1%	0.2	0.1%

N.D. = Value cannot be disclosed. Where data represent fewer than 5 individuals/vessels/companies, their value cannot be disclosed for data protection reasons.

6.3 Distribution of Economic Costs – Fishing Groups

6.3.1 Table 31 presents the annual average loss of the value of landings by gear type and vessel length, by region. Under the intermediate estimate, the majority (95%) of impacts are for demersal trawls in the over-12 m sector, primarily in the Moray region. A further 3% of impacts are for demersal trawls by under-12m vessels in the Moray and North Minch regions.

6.3.2 In the upper estimate, the same gear types and regions are affected, arising predominantly for over-12 vessels (97% of the total in the upper estimate). This stems from demersal trawls in the Moray region (95% of total in the upper estimate).

Table 31. Annual Average Loss of Landings by Gear Type and Vessel Length, by Region of Site £'000

	Lower Scenario					Intermediate Scenario					Upper Scenario				
	Total by Region				Sum	Total by Region				Sum	Total by Region				Sum
	Buch-an	Moray	North Minch	South Minch	All	Buch-an	Moray	North Minch	South Minch	All	Buch-an	Moray	North Minch	South Minch	All
Over-12m vessels															
Demersal seines	-	-	-	-	-	0.3	2.0	-	-	2.3	0.6	3.9	-	-	4.5
Demersal trawls	-	-	-	-	-	4.5	221.0	26.4	-	251.8	9.0	441.9	45.3	-	496.2
Mechanical & suction dredges	-	-	-	-	-	0.1	1.5	0.2	2.3	4.1	0.2	2.2	0.3	2.3	5.0
TOTAL >12m	**-**	**-**	**-**	**-**	**-**	**4.9**	**224.4**	**26.6**	**2.3**	**258.2**	**9.8**	**448.1**	**45.5**	**2.3**	**505.7**
Under-12m vessels															
Demersal trawls	-	-	-	-	-	0.0	4.7	3.1	-	7.8	0.0	9.3	4.3	-	13.6
Drift nets	-	-	-	-	-	-	-	0.0	-				0.0	-	
Set nets	-	-	-	-	-	-	-	0.0	-	0.0	-	-	0.0	1.1	1.1
Mechanical & suction dredges	-	-	-	-	-	0.0	0.0	0.4	0.0	0.5	0.0	0.1	0.6	0.0	0.7
TOTAL <12m	**-**	**-**	**-**	**-**	**-**	**0.0**	**4.7**	**3.5**	**0.0**	**8.2**	**0.0**	**9.4**	**4.9**	**1.1**	**15.4**
TOTAL	**-**	**-**	**-**	**-**	**-**	**4.9**	**229.1**	**30.1**	**2.4**	**266.4**	**9.8**	**457.5**	**50.5**	**3.5**	**521.1**

Buchan: Southern Trench pMPA
Moray: Southern Trench pMPA
North Minch: North-east Lewis pMPA, Shiant East Bank pMPA, Sea of Hebrides pMPA
South Minch: Sea of the Hebrides pMPA

6.4 Fish Processing Industry

6.4.1 In the Scottish fish processing industry, there are 111 businesses processing sea fish[77]. It is clear from Table 32 that processing activity is concentrated in the north-east of Scotland (Grampian) with more modest levels of processing activity in "Other Scotland" and in the Highlands and Islands (where processing is on a smaller scale). 50% of processing units are located in Grampian and together they account for over 70% of total employment in the fish processing industry in Scotland.

Table 32. Number of Sea fish processing units in Scotland and industry employment, 2016.

Area	Sea Fish Processing Units	Industry FTE Employment
North East (Grampian)	56	3,439
Other Scotland	38	888
Highland and Islands	17	446
Total	**111**	**4,774**

Source: SeaFish, 2016[78]

6.4.2 No management measures are anticipated for wild salmon and sea trout fisheries, and these processing units would predominantly be processing farmed salmon. No impacts are expected, therefore, on the Scottish salmon processing industry.

6.4.3 Management scenarios are, however, anticipated to restrict commercial fishing activity, and have the potential to reduce the quantity and quality of seafish and shellfish landed locally at Scottish landing ports. This could reduce the supply of locally-landed catch to fish processing facilities and the hotel/restaurant, retail and wholesale trades, and/or reduce confidence and hence investment in these sectors, in particular, the fish processing industry. The significance of the economic impact will develop upon various factors, including:

- The extent to which the landings of different species are affected (i.e. pelagic, demersal shellfish) and the dependency of different processing units on these species;
- The distribution of affected landings across landing ports/regions and the dependency of landing ports on the affected landings; and

[77] All marine fish including shellfish (excludes salmon and trout). SeaFish 2016. Seafood processing industry report. Available at: http://www.seafish.org/research-economics/industry-economics/processing-sector-statistics.

[78] SeaFish 2016. Seafood processing industry report. Available at: http://www.seafish.org/research-economics/industry-economics/processing-sector-statistics.

- The dependency of fish processing units in these regions/ports on processing locally landed catch, and their ability to offset reductions in local landings with landings that would have gone to ports where impacts are lower, and/or with imported fish.

6.4.4 The MPA socio-economic monitoring report[79] found little evidence of these effects from existing management measures in designated sites. However, it should be noted that further effects may become evident over a longer time period.

6.4.5 Table 33 shows the distribution of all the lost landings from the sites across Scotland. Only Ports with more than 0.1% of lost landings impacts under the intermediate scenario are shown (i.e. more than 0.1% of the total landings affected across Scotland from all sites are landed at that port). The port with the largest proportion of the affected landings is Fraserburgh (78% of the total impacts across Scotland). No other port has more than 4% of the total (Stornoway), while Buckie, Macduff, Peterhead, Gairloch and Ullapool all have more than 2%. Under the upper estimate, the most significantly impacted ports are the same, with Fraserburgh accounting for 80% of the total impacts across Scotland.

6.4.6 The size of the impact on these ports depends on the relative importance of the landings affected within their total landings. The impacts as a percentage of the total landings at each port are shown in Table 34. Under the intermediate estimates, the most significant impacts are at Gareloch[80] (16% of landings at the port are affected – but note this is a very low £ amount), followed by Macduff and Fraserburgh (< 1% respectively).

6.4.7 Under the upper estimate, significant impacts are more widespread. Gareloch[80] faces similar impacts (18%), with Macduff experiencing higher impacts as well (2%). Fraserburgh, Gairloch, Buckie and Stornoway have 1% of landings at the port affected.

6.4.8 At several of these locations identified under the intermediate and upper estimates, the impacts could potentially affect local fish processing businesses, due to the scale of the landings affected. There is a risk that this could have social consequences, as identified in Table 28. This is particularly the case if a large proportion of landings are potentially affected, and if there are fish processing businesses within remote communities. However, the high percentage of landings affected can be a reflection of the very small size of the port (such as Gareloch), as well as the absolute size of the impact.

[79] Marine Scotland Science, 2017. Scotland Marine Protected Areas Socioeconomic Monitoring. 2016 Report. Marine Analytical Unit, Marine Scotland Science, Scottish Government. Available online at http://www.gov.scot/Resource/0051/00514589.pdf. Accessed 19 April 2018.

[80] Landings data indicate a small amount of landings are made to Gareloch, however it is not clear whether this has been misinterpreted and may relate to Gairloch

Table 33. Landings affected as a percentage of total affected landings

Port of Landing	Scenario		
	Lower	Intermediate	Upper
	% Total affected landings		
Aberdeen		0.2%	0.1%
Buckie		3.3%	3.3%
Burghead		0.4%	0.4%
Fraserburgh		78.2%	79.9%
Gairloch		2.3%	1.9%
Gareloch		0.1%	0.1%
Kinlochbervie		0.2%	0.2%
Lochinver		1.3%	0.9%
Macduff		2.9%	2.9%
Mallaig		0.5%	0.4%
Oban		0.9%	0.5%
Peterhead		2.5%	2.5%
Portree		0.3%	0.2%
Stornoway		3.8%	3.7%
Uig		0.9%	0.7%
Ullapool		1.8%	1.6%

Table 34. Landings affected as a percentage of total landings at each port

Port of Landing	Scenario		
	Lower	Intermediate	Upper
	% of total landings to port		
Aberdeen	0.0%	0.0%	0.0%
Buckie	0.0%	0.3%	0.6%
Burghead	0.0%	0.1%	0.2%
Fraserburgh	0.0%	0.6%	1.2%
Gairloch	0.0%	0.4%	0.6%
Gareloch	0.0%	16.3%	18.2%
Kinlochbervie	0.0%	0.0%	0.0%
Lochinver	0.0%	0.0%	0.0%
Macduff	0.0%	0.8%	1.5%
Mallaig	0.0%	0.0%	0.0%
Oban	0.0%	0.1%	0.1%
Peterhead	0.0%	0.0%	0.0%
Portree	0.0%	0.0%	0.1%
South Uist and Eriskay	0.0%	0.0%	0.2%
Stornoway	0.0%	0.3%	0.5%
Uig	0.0%	0.1%	0.2%
Ullapool	0.0%	0.0%	0.1%

Impact on Incomes

6.4.10 The average wages for employees in fish processing and fishing are shown in Table 35 and Table 36. They show the lower wages in the fishing industry, and therefore the potential for management scenarios to have a greater impact on lower income groups, as identified in Table 27.

Table 35. Gross wages and salaries per employee for the processing and preserving of fish, crustaceans and molluscs, 2014-16

Scotland: Processing and Preserving Fish, Crustaceans and Molluscs (SIC 10.2)	2014	2015	2016
Gross Wages & Salaries per employee (£)	20,939	23,564	21,208

Source: Scottish Government, 2018[81]

Table 36. Gross wages and salaries per employee in the Scottish fishing industry, 2014-16

Scottish Fishing (SIC 03.1)	2014	2015	2016
Gross Wages & Salaries per employee (£)	11,426	17,747	10,310

Source: Scottish Government, 2018[82]

Economic Importance of the Commercial Fishing Sector to the Scottish Economy and Sustainable Economic Growth

6.4.11 Scotland's sea-fishing industry is estimated to contribute approximately 0.19% to total Scottish GVA[83] and 0.30% of GVA when the indirect and induced effects throughout the Scottish economy are added. Total employment in the sea-fishing industry was 4,799 in 2017[84], which is 0.2% of the labour force in Scotland. The total effect on employment (taking account of indirect and induced effects) is estimated to be 4 full time equivalent (FTE) jobs under the intermediate estimate, which is 0.0002% of the labour force in Scotland, and 0.1% of sea-fishing industry employment. It should be noted that some of those employed may work part-time, so 4 FTE may translate into more than 4 employees. The fact that most of the fish catching industry in Scotland is concentrated in coastal areas and islands means it has an important role to play in ensuring that these parts of Scotland contribute to, and share in, future economic growth.

[81] Scottish government. (2018). Scottish Annual Business Statistics 2016. Available at: https://www2.gov.scot/Topics/Statistics/Browse/Business/SABS

[82] Ibid.

[83] £251m of GVA out of Total Scottish GVA is estimated at £134 billion (Scottish Parliament, 2018).

[84] Scottish Government (2018). Scottish Sea Fisheries Statistics 2017. Available at: https://www.gov.scot/publications/scottish-sea-fisheries-statistics-2017/

6.4.12 The most recent sea fisheries statistics[85] show that the value of fish landed by Scottish vessels increased by 1% in real terms from 2016 to 2017. In 2017, 465,000 tonnes of fish and shellfish were landed by Scottish vessels with a value of £560 million.

6.4.13 The commercial fishing sector, therefore, has a contribution to make to Scotland's economic growth, and an important contribution in terms of ensuring that all parts of Scotland share in that growth. In 2017, although Scotland had only 8.2% of the UK population[86], it landed 67% of the total value of fish landed at UK ports[87]. The industry is therefore of much greater economic (and social and cultural) importance to Scotland than to the rest of the UK.

6.4.14 Table 37 presents the impact which the management scenarios (under lower, intermediate and upper estimates) could have on the GVA generated by the fishing sector in Scotland and GVA generated by the fishing sector and its supply chain.

6.4.15 Table 37 shows that over the study period, the potential direct impact is a reduction in GVA of between £0 (lower estimate), £1.5 million (intermediate estimate) and £2.9 million (upper estimate). The potential direct and indirect impact on GVA is a reduction between £0 (lower estimate), £2.1 million (intermediate estimate) and £4.2 million (upper estimate) over the study period. Note that these are total impacts over 20 years. The annual impacts represent approximately 0% to 0.1% of the sector's annual GVA[88].

6.4.16 As indicated in Table 38, the proposed management scenarios are estimated to lead to between 0 and 8 full-time equivalent jobs being lost directly and indirectly throughout the Scottish Economy, across the estimates. This represents between 0% and 0.2% of total full-time jobs created directly and indirectly by the Scottish fishing industry.

6.4.17 Table 38 shows the number of direct, indirect and induced jobs affected, per site where management scenarios are proposed. Management scenarios proposed for the Southern Trench MPA account for much of the employment impact – around 90% of the jobs impacts under the intermediate estimate. This also holds true under the upper estimate.

6.4.18 An important consideration is whether ports will be affected by a combination of impacts on commercial fishing (assessed by impact on landings by vessels' home port) and on fish processing (assessed by impact on landings by port of landing). Under the intermediate estimate, only Fraserburgh has a risk of being

[85] Scottish Government (2018). Scottish Sea Fisheries Statistics 2017. Available at: https://www.gov.scot/publications/scottish-sea-fisheries-statistics-2017/

[86] Office for National Statistics (2018). Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2017. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2017

[87] Marine Management Organisation (2018). UK Sea Fisheries Statistics 2017. Available at: https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2017.

[88] GVA for Scottish fishing industry is estimated at £251 million per year.

significantly affected in both senses – with 3.1 jobs (direct + indirect) and 1% of landings to the port potentially affected. Under the upper estimate, these impacts on Fraserburgh increase (6.2 jobs and 1% of landings).

Table 37. Impact on GVA for the Commercial Fishing Sector (Direct Impact and Direct plus Indirect Impact) over the 20 year assessment period, Present Value, 2019 prices, £'000s.

Site Name	Quantified GVA Impact over Assessment Period (Present Value of Total Costs, £'000)					
	Lower		Intermediate		Upper	
	Direct	Direct + Indirect	Direct	Direct + Indirect	Direct	Direct + Indirect
North-east Lewis	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Sea of the Hebrides	0	0	16	23	25	36
Shiant East Bank	0	0	177	257	296	429
Southern Trench	0	0	1,288	1,864	2,570	3,721
Total*	0	0	1,481	2,144	2,892	4,187

N.D. = Value cannot be disclosed. Where data represent fewer than 5 individuals/vessels/companies, their value cannot be disclosed for data protection reasons.

* Excluding undisclosed sites.

Table 38. Average (mean) Number of Direct, Indirect and Induced Jobs Affected, year-on-year over 2019-2038, FTEs

Site Name	Estimated Employment Impact (Number of Direct & Indirect Jobs)			Estimated Employment Impact (Number of Direct, Indirect & Induced Jobs)		
	Lower	Intermediate	Upper	Lower	Intermediate	Upper
North-east Lewis	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Sea of the Hebrides	0.0	0.0	0.1	0.0	0.1	0.1
Shiant East Bank	0.0	0.5	0.8	0.0	0.5	0.8
Southern Trench	0.0	3.5	7.1	0.0	3.8	7.6
Total*	0.0	4.0	7.9	0.0	4.4	8.5

N.D. = Value cannot be disclosed. Where data represent fewer than 5 individuals/vessels/companies, their value cannot be disclosed for data protection reasons.

* Excluding undisclosed sites.

6.4.19 Under the intermediate and upper estimates, the estimated loss of GVA would clearly have a small negative effect, but the impact at the Scottish economy and sectoral level is minor. Under the upper estimate, the impact is higher, but still represents less than 1% of the sector's GVA and employment. Furthermore, these estimates are considered to overestimate the likely impacts as they assume that all fishing effort and associated landings is lost rather than being displaced (even though some displacement is likely).

6.4.20 The employment impacts also assume that reductions in GVA will automatically translate into job losses. In reality, vessels are likely to be able to absorb some small reductions in turnover and hence profit without that having any impact on employment. Further, even where the reductions in GVA are significant enough to affect employment, vessel owners have a number of alternative options before having to make fishermen redundant (e.g. reduction in wages, reduction in hours).

6.4.21 The point at which reductions in profits starts to impact on employment issues will be different for the owners of different vessels. Rather than apply an arbitrary estimate of the threshold below which businesses would be able to absorb costs, it has been assumed that all losses in GVA translate directly into lost employment. The estimates presented above, therefore are considered likely to over-estimate the economic impacts generated by the proposals.

6.4.22 Although the GVA and employment impacts are relatively small at the Scottish economy and sectoral level, they could have more significant economic and social consequences for the specific locations, individuals and communities that are affected. The scale and significance of impacts will depend on who bears the costs and the relative vulnerability of the local economies, fishing sectors and social groups upon which they fall. A distributional analysis has therefor been undertaken and is presented in Section 6.5.

6.5 Distribution of Economic Costs – Groups

6.5.1 The following sections relate to overall activity connected to fishing – the commercial fishing sector, upstream supply chain and downstream supply chain, including fish processing.

Age and Gender

6.5.2 The proposed management scenarios have the potential to put between 4 and 9 FTE jobs at risk in the commercial fishing sector and its supply chain. These impacts are most likely to fall on those of working age, and on men who make up the vast majority of those employment in commercial sea fishing. There could be further employment impacts in downstream activities like fish processing, which are likely to be more evenly distributed between men and women.

6.5.3 These impacts could generate economic and social costs for the individuals concerned and for their families (including children) at the upper levels.

However, some displacement of fishing activity is likely to occur and hence the impacts on employment are likely to be lower than the maximum estimate.

Income

6.5.4 The gross wages and salaries of fishermen are likely to have considerable variation across fleets and roles in the sector, and include individuals in the lowest-paid 10% of the Scottish economy's workforce. It is likely, therefore, that the proposed management scenarios at the sites could impact on income groups falling into the lowest paid 10% and the middle 80% of workers.

Social Groups

6.5.5 There is no information to our knowledge that provides information on the ethnic origin of fishermen employed on Scottish-based vessels. It is not anticipated, however, that there would be any significant impacts on crofters, ethnic minorities, people with disabilities or other social groups.

6.6 Consequential Social Impacts

6.6.1 Further potential social impacts in the local communities affected, such as on culture, heritage, crime, health education access to services, or changes to the local environment are not considered likely to occur.

6.7 Conclusions

6.7.1 For the majority of sites, and ports likely to have their fishing fleets or landings affected, the estimated economic impacts are minor under the intermediate estimate. There are exceptions to this for the sites (Southern Trench), and ports (e.g. Fraserburgh) where there is a risk of small but noticeable impacts under the upper estimate.

7 Impacts to Ecosystem Services

7.1 Approach

7.1.1 This section considers the range of benefits that could arise from the proposed MPAs management scenarios. These benefits are assessed based on the implementation of the proposed management scenarios used to consider the likely costs in previous sections. As with the costs, a range of benefit estimates (lower, intermediate, upper) reflect the range of likely future management approaches.

7.1.2 MPAs are focused on protecting particular features of interest in the marine environment. Those features can be geological, habitats or species. They are identified on conservation grounds, and therefore are subject to moral and philosophical arguments about the appropriateness and benefits of their protection. This analysis focuses on the economic arguments for their protection, which are regarded as separate from, but not superior to, moral or other arguments.

7.1.3 This analysis of benefits adopts an ecosystem services approach. It is important to note that it assesses the expected changes in ecosystem services as a result of implementing management measures – it is not an assessment of the total ecosystem services arising from the sites. The change in ecosystem services is assessed relative to the baseline of the expected condition of the sites in the absence of additional management. This is a source of uncertainty, as the extent and condition of the features of the proposed sites, and their response to existing management measures, are not always well understood.

7.1.4 A qualitative approach has been adopted to assessing the potential benefits within each site (see individual Site Reports presented in Table 6a of Appendix C). Table 6b considers whether there are any negative *changes* (costs) to ecosystem services as a result of the proposed management scenarios.

7.1.5 Both ecosystem service benefits and costs could arise on-site or off-site. On-site benefits are the result of management protections of features. Off-site benefits include spill-over effects, where particular species (including commercial fish or shellfish species, and other protected biodiversity) have healthier populations inside the site, and this supports movement of individuals to areas outside the site. The extent of this effect depends, amongst other things, on the size of site, impact of management measures and mobility and lifecycles of the species concerned.

7.1.6 Ecosystem service costs that could arise on-site, for example if alternative fishing activities (using different gears), enter areas where restrictions are introduced on existing fishing activities. Costs could also arise off-site, where a significant amount of fishing activity is expected to be displaced from the site to other areas where they could have a negative effect.

7.1.7 The on-site/off-site distinction in Tables 6a and 6b of the Site Reports in Appendix C reflect the ecosystem providing the services analysed. It does not relate to the location of people benefiting from the services.

7.1.8 This section firstly considers the ecosystem services likely to be affected by the proposed management scenarios. It then discusses the overall benefits of the proposed measures across the sites, and any synergies (or network effects) arising from their collective implementation.

7.2 Ecosystem Services from the Marine Environment

7.2.1 A healthy marine environment provides a large number of benefits to human populations. The benefits and the beneficiaries are not uniform and cover a wide range of ecosystem functions and interdependencies. The concept of 'ecosystem services' is used to capture the benefits provided. Ecosystem services are the outcomes from ecosystems that directly lead to good(s) that are valued by people[89].

7.2.2 The ecosystem service concept provides a framework to identify the range and type of benefits provided by an ecosystem. This section uses the terminology from the UK National Ecosystem Assessment (2010, first used in the Millennium Ecosystem Assessment, 2005), which is applied in subsequent UK analysis of MPAs (e.g. Burdon *et al*.[90]). It splits the benefits provided by UK environments into the following services:

- Provisioning Services – the tangible goods and associated benefits produced by an ecosystem;
- Regulating Services – the benefits from the regulation of ecosystem processes;
- Cultural Services – the non-tangible ecosystem benefits either from experience of the ecosystem or knowledge of its existence;
- Supporting Services – those services whose function underlie all other ecosystem service provision.

7.2.3 The ecosystem services considered in Tables 6a and 6b are a subset of those relevant to the Scottish marine environment. The list of services being used by SNH to inform policy development distinguishes final ecosystem services and those goods/benefits received by people for cultural, regulating and provisioning services, as shown in Table 39. Supporting services are not measured separately in economic analysis, since their contribution is reflected in final services and benefits.

7.2.4 The typology in Table 39 has been used to identify the services for analysis in relation to the sites' proposed management scenarios.

[89] Natural Capital Committee, 2013, State of Natural Capital Report. Natural Capital Committee, Defra.

[90] Burdon D, Potts T, Barbone C, Mandera L., 2017. The matrix revisited: A bird's-eye view of marine ecosystem service provision. *Marine Policy* 77; 78–89.

7.2.5 The definitions of the services identified in Table 39 are defined by SNH as follows:

- Regulating services
  - Carbon storage & climate regulation – storage or sequestration of organic or inorganic carbon within biomass or sediment or geological material;
  - Natural coastal protection – habitats and geomorphology which attenuate or block wave energy from reaching parts of the coast and foreshore with sensitive natural or built assets;
  - Waste breakdown & detoxification of water & sediment – physical or chemical change to organic or inorganic contamination levels of water or sediment by species/habitats that remove contaminants through consumption or filtering, or otherwise help lock contaminants in to substrate.
- Provisioning services:
  - Fish & shellfish stocks – harvestable wild fish and shellfish for commercial market or personal use / recreational fishing;
  - Harvestable seaweed – seaweed collectable for commercial or personal use;
  - Ornamental material (commercial & personal) – shells or other natural material collected for display or as trinkets/memorabilia, whether for commercial sale or personal use;
  - Genetic resources – species with potential use in, for example, biomedicine, food/nutrition or cosmetics, whether as raw material or isolation of genetic properties; and
  - Aggregate / sand – sediment and rock resources identified as for potential extraction and use in construction.
- Cultural services
  - Socially valued places – Locations which society or parts of society (i.e. communities of place or interest) place some non-monetary value upon, regardless of whether or not they actively use or enjoy the natural assets at that location (i.e. people can acquire a level of well-being from their knowledge of the natural environment and its health);
  - Seascape – the aesthetic qualities and character (visual and sense of place) of areas of sea or coast with which human society has a connection; and
  - Wildlife – species and habitats which people enjoy, study or observe.

7.2.6 The typology in Table 39 has been used to identify the services for analysis in relation to the sites' proposed management scenarios.

Table 39. Typology of Scottish marine final ecosystem services, and resulting goods and benefits

	Provisioning	Regulating	Cultural
Final ecosystem services	Fish & shellfish Other edible species Seaweed (non-edible) Ornamental materials (commercial & personal) Genetic resources Aggregate / sand	Climate regulation Natural coastal protection Waste breakdown / detoxification	Socially valued places Seascape Wildlife
Goods/ benefits	Food Fish feed Fertiliser Ornaments (incl. aquaria) Medicine, cosmetics & biotech Construction materials	Healthy climate Prevention of coastal erosion Sea defence Clean water & sediments Immobilisation of pollutants	Tourism & recreation Nature watching Mental health Physical health Spiritual/cultural well-being Aesthetic benefits Knowledge (science & education)

Source: SNH

7.3 Ecosystem Services from Marine Protected Areas

7.3.1 Previous work[91] linked the features in the proposed Scottish MPAs to different ecosystem services to provide a guide to the levels of ecosystem services that may be provided by the sites. This needs to be combined with understanding of the status and threats to site features, and the extent of the proposed management scenarios for the designated area, in order to predict possible changes in associated ecosystem services. The timing of ecosystem service benefits is also uncertain. Experiences in temperate marine ecosystems indicate that recovery of seabed habitats following impacts from human pressures can occur over a range of time scales from less than one year to many years, depending on the features affected. For example, recovery of fish populations has also been observed over a range of time scales, depending on the scale of impact and the life cycles of the species affected.

7.3.2 This information set remains subject to considerable uncertainty. As identified by Potts *et al.*[92] "Underlying the use of the ecosystem services approach to inform MPA designation is the paucity of data. The availability of data on the functioning (i.e. what ecological configurations and levels of biodiversity provide

[91] ABPmer & eftec, 2015. The Scottish Marine Protected Area Project Second Iteration of Site Proposals – Developing the Evidence Base for Impact Assessments: Final Report. Report to Marine Scotland, September, 2015.

[92] Potts T, Burdon D, Jackson E, Atkins J, Saunders J, Hastings E, Langmead O., 2014. Do marine protected areas deliver flows of ecosystem services to support human welfare? *Marine Policy* 44; 139–148.

what services) and value of those services to society is a major obstacle to the implementation of policy".

7.3.3 Subsequent work has added to the evidence base (e.g. Burdon *et al.*[93] on seabirds) but not resolved this data gap on ecosystem service flows and goods/ benefits from habitats and species. Schratzberger *et al.*[94] identified that in contrast to the ecological evidence surrounding highly protected marine areas, systematic reviews and quantitative meta-analyses of the socio-economic effects of these areas relative to other types of MPA are not available at present.

7.3.4 In addition to a partial evidence base, the benefits analysis is mainly based on consideration of ecosystem services from protected features (due to the available information). In reality, MPAs are likely to contain marine biodiversity features that are not designated features but which give higher levels of ecosystem services as a result of protection under site management scenarios.

7.3.5 As a result of these uncertainties, a key part of the ecosystem services analysis for each site is that the level of confidence in each assessment is explicitly recorded. In general, confidence is only moderate or high for ecosystem services which are not expected to change significantly at a site. For most potential positive impacts at individual sites, the analysis of ecosystem services changes has low confidence.

7.3.6 Several of the services in Table 39 are hard to quantify and measure at a site level, and/or lack evidence as to how they could change as a result of fisheries management measures. For this reason, some services (such as Genetic resources, and Spiritual/cultural well-being) are not included in the site-level analysis.

7.3.7 Other services are not considered relevant to the site management scenarios. For example, management of fisheries impacts on benthic communities are unlikely to have a noticeable impact on natural coastal protection. Recovery of biogenic reef forming habitats could provide this service, but these habitats tend to be in more sheltered environments and are not very extensive, so are not considered relevant to the management scenarios for the pMPAs.

7.3.8 These services are also not included in the ecosystem services considered at a site level.

7.3.9 The list of ecosystem services included reflects those covered in ABPmer & eftec[95], but the wording of these has been updated to reflect the typology in Table 39. Specifically, this has led to the adjustments shown in Table 40.

[93] Burdon D, Potts T, Barbone C, Mandera L., 2017. The matrix revisited: A bird's-eye view of marine ecosystem service provision. *Marine Policy* 77; 78–89.

[94] Schratzberger M, Paltriguera L, Neville S, Weston K, Painting S, 2016, Review of Highly Protected Marine Areas. Final Report.

[95] ABPmer & eftec, 2015. The Scottish Marine Protected Area Project Second Iteration of Site Proposals – Developing the Evidence Base for Impact Assessments: Final Report. Report to Marine Scotland, September, 2015.

Table 40. Adjustments to ecosystem services terminology

ABPmer and eftec (2015)	This Report
Fish for human consumption	Fish and shellfish for human consumption
Fish for non-human consumption	Fish and shellfish for non-human consumption
Gas and climate regulation	Climate regulation
Regulation of pollution	Waste breakdown/detoxification

7.3.10 It is noted that the list of ecosystem services used contains both final services and goods/benefits to people from Table 39. This reflects the practicalities of being able to identify evidence for services or goods/ benefits, and a desire to retain consistency with the previous typology used to assess impacts of MPA designation and management in Scottish waters. The list does not contain overlaps between services and goods/benefits, so there is no risk of double-counting.

7.3.11 Some key issues in the assessment of levels of different ecosystem services in the site assessments are discussed below.

Provisioning Services

7.3.12 The proposed management scenarios for the MPAs could increase the level of several provisioning services. The most significant provisioning service is of fish (and shellfish) for human consumption. While the status of commercial fish stocks in UK waters are variable and not fully known, the assessment is based on the fact that UK populations of several important commercial species are at suboptimal levels. It is assumed that protected areas can potentially help with stock recovery.

7.3.13 This can result from reduction of fishing pressures, and in particular from protection of key stages (e.g. spawning, nursery grounds) in species' life cycles. Providing spatial or species protection, has been shown to boost populations, which potentially can have a benefit on fishery yields. As expected, there is more evidence for shellfish in this regard: In Lundy it has been shown that there is the potential for spillover benefits from no-take zones into the surrounding lobster population. On Skomer, the scallop population has increased four to eight fold over 20 years of protected area designation according to anecdotal evidence. In the Lyme Bay statutory fishing closure, the increased densities of scallops have spilled over into surrounding areas.

7.3.14 Gubbay[96] found some evidence of positive species community effects such as greater complexity of food webs and increased primary and secondary productivity in MPAs as a consequence of protection. This study considered habitats relevant to the MPAs: Seagrass beds; Kelp forests; Mussel beds;

[96] Gubbay, S., 2006. Marine Protected Areas. A review of their use for delivering marine biodiversity benefits. English Nature Research Reports, No 688.

Maerl beds; and Sediment communities. Fernández-Chacón *et al.*[97] identified that a partially protected area off the coast of Norway increased survival and stimulated movement of Atlantic cod (*Gadus morhua*) to surrounding areas.

7.3.15 For mobile fish species spillover benefits are complex, and the benefits of the management scenarios will depend on several factors, in particular the implementation of CFP reforms and UK and Scottish fisheries policies post-Brexit, which remain uncertain. The actual impact of protected areas on fish stocks is known to depend on many factors including the size of the MPA, its position in an MPA network, the size of that network, the mobility of the species, the distribution of fishing effort and so on. Detailed modelling of these issues is beyond the scope of this work.

Regulating Services

7.3.16 Two regulating services are considered in the analysis. Carbon sequestration is more significant where there is primary productivity from benthic vegetation in a site. Waste assimilation services are provided by protected features within some sites (e.g. maerl beds) but to be a valuable service there needs to be a source of waste that is affecting water quality. Actions under the Water Framework Directive (WFD) are assumed to be dealing with any significant impacts on coastal water quality, so any benefits of management scenarios in improving water quality in excess of WFD requirements are assumed to be very low. However, a healthy inshore environment could enhance waste assimilation functions and so contribute to water quality in excess of WFD standards, which could have benefits (e.g. to recreational visitors).

7.3.17 It is possible that disturbance of sediments by mobile benthic gear causes release of carbon which then can be emitted from the marine environment as greenhouse gases (Prof. Kerry Turner, University of East Anglia, pers com). The available evidence does not suggest the impacts of the site management scenarios on this stored carbon will have a significant value in relation to the overall costs and benefits of site designation and management. However, this should be kept under review as further research is ongoing in this area.

7.3.18 The regulating services assessed are not considered significant for most sites, but in general the available evidence means it is not possible to quantify any of the potential benefits accurately, and so they are not considered further in this analysis.

Cultural Services

7.3.19 Cultural services are the least-well understood group of final ecosystem services from the marine environment. The significance of the management scenarios has been assessed for research and education, recreation activities, and non–use benefits. It can be argued that the sites produce a range of other

[97] Fernández-Chacón, A., Moland, E., Espeland, S. & Olsen, E. (2015). Demographic effects of full vs. partial protection from harvesting: inference from an empirical before-after control-impact study on Atlantic cod. *J Appl Ecol*, 52, 1206–1215DOI:10.1111/1365-2664.12477

cultural values. These include direct use values such as the maintenance of traditional fishing communities. The typology in Table 39 also includes more indirect values such as meaningful places or socially valued landscapes, symbolic benefits (aesthetic, heritage, spiritual), and philosophical, inspiration values. However, there is little conclusive evidence on the likely impacts of management measures on these issues.

7.3.20 Most of the sites have some recreational activities (e.g. scuba diving, angling, nature watching, recreational boating routes and anchorages), and the value of these activities may be enhanced by designation and management if users of sites will encounter higher levels of biodiversity and environmental quality. The value of non-use benefits is considered further under the valuation evidence below.

Supporting Services

7.3.21 MPAs provide a significant number of supporting services. These services are the foundation for all other ecosystem services. Perhaps most significantly is the support that these services provide for provisioning services such as the protection of features which provide habitats for larval and juvenile life stages of marine species. Broadscale marine habitats provide important intermediate (supporting and regulating) services such as the formation of species habitat and physical barriers[98]. Where relevant to the features protected by management scenarios, these benefits are reflected in the fish and shellfish provisioning services.

Ecosystem Services Costs

7.3.22 The above discussion relates to Table 6a in the Site Reports in Appendix C, which considers ecosystem service benefits. Table 6b considers ecosystem service costs that might arise from displacement of fishing effort (off-site) and use of alternative fishing gears (on-site). Displacement is only considered under the lower scenario for consistency with SEIAs of other proposed MPA management scenarios. Displacement of fishing effort to other areas would result in additional landings that would offset the loss of landings from the pMPA areas, and therefore reduce the size of the impact on the fishing sector. The intermediate and upper estimates are assumed to have no displacement, and hence higher direct impacts on the fishing sector.

7.3.23 The site assessments suggest that there would be a small amount of displacement of effort by over-12 m vessels due to the proposed management scenarios at the Southern Trench site.

7.3.24 This displaced effort could have detrimental effects on the ecosystem services provided by the areas it is displaced to. However, these effects would be expected to be less than the benefits in the sites because:

[98] Potts T, Burdon D, Jackson E, Atkins J, Saunders J, Hastings E, Langmead O., 2014. Do marine protected areas deliver flows of ecosystem services to support human welfare? *Marine Policy* 44; 139–148.

- The effort will usually be displaced to larger areas, so would be spread more thinly, than the proposed fisheries management measure areas.
- The areas displaced to would overall be expected to have less sensitive and/or significant marine conservation features, as this should be the basis for site identification.

7.3.25 The proposed fisheries management measure areas where fishing gears are restricted could be subject to new fishing activity with alternative gears (e.g. creels). These gears would be less damaging than the gears restricted (otherwise they would also be restricted) but could nevertheless have a negative impact on site features and ecosystem services. For example, if creeling were to capture the largest shellfish, this could reduce population recovery and the potential for spillover benefits from sites to neighbouring areas.

7.4 Values of Benefits from Designation and Management in MPAs

7.4.1 As discussed above and analysed for each site, the ecosystem services changes expected from the proposed management scenarios produce a variety of benefits to people. An attempt can be made to identify the economic value of these benefits. However, much of the valuation evidence available is uncertain, and the evidence base has very significant gaps. When combined with the uncertainties over the levels of ecosystem services changes, this makes accurate valuation of the full benefits of the management scenarios difficult. The timing of realisation of benefits is also uncertain.

7.4.2 In order to gauge the ecosystem services accruing from marine protected areas, relevant valuation literature has been assessed including a recent review prepared as part of the NEA Follow-On project Marine chapter[99] and Turner and Schaafsma[100].This section considers additional values from individual MPAs.

Provisioning Services

7.4.3 By their very nature provisioning services are those services most closely tied to the market economy. Goods (fish, shellfish, oil, gas) from marine ecosystems are sold in existing markets and so have a market value: the total value of Scottish fish landings was £560 million in 2017[101]. Such market values do not include the externalities of extracting the good from the ecosystem.

[99] Austen, M., Malcolm, S., Frost, M., Hattam, C., Mangi, S., Stentiford, G., 2011. Marine. In: The UK National Ecosystem Assessment Technical Report. UK National Ecosystem Assessment. Cambridge: UNEP-WCMC.

[100] R.K. Turner and M. Schaafsma eds (2015) Coastal Zone Ecosystem Services, ch 6, Springer, Switzerland.

[101] Scottish Government (2018). Scottish Sea Fisheries Statistics 2017. Available at: https://www.gov.scot/publications/scottish-sea-fisheries-statistics-2017/

7.4.4 It is reasonable to assume that protection by the proposed management scenarios of features in MPAs that are important for fish and shellfish lifecycles (e.g. mussels, seagrass) are likely to increase the health and size of stocks. This will benefit commercial fisheries in surrounding areas, but it is not possible to quantify this likely benefit.

7.4.5 Other provisioning services are also difficult to quantify, particularly at a site level. For example, Potts *et al.*[102] identified medicines and blue biotechnology as an important marine service. However, apart from horse mussels, they could only cite expert opinion on the importance of a range of habitats and species for this benefit.

Regulating Services

7.4.6 Marine regulating ecosystem services provide some essential functions. For example, carbon sequestration and storage in the marine environment helps regulate the global climate. Marine regulating services are generally difficult to quantify in scientific terms and therefore are difficult to value in monetary terms. Given the size of habitat features and management scenarios being considered, the value of impacts of the proposed management scenarios on regulating services are not expected to be high.

Cultural Services

7.4.7 The majority of cultural services from the marine environment are dependent on the quality of the marine environment, which is likely to be enhanced (or is less likely to be degraded) by the proposed management scenarios. However, the extent of this improvement is very hard to predict.

7.4.8 Cultural services and non-use values are classified in different ways in different marine ecosystem services studies. The main evidence available relates to non-use value for biodiversity (see below) and use values for recreation, therefore the following analysis looks at these two areas in detail. Other cultural services, such as the value of research and education, are hard to quantify or value either in total or in terms of the expected changes from management scenarios. However, they could be significant if sites are subject to long-term research studies.

Recreation and Tourism

7.4.9 The marine environment provides a location for recreational activities and tourism, with many if not all activities to some extent linked to the quality of the marine environment. Much ‘marine’ recreation activity relates to beaches, and therefore is not always relevant to the expected impacts of MPA management. However, some valuation evidence for marine recreation and tourism is available. This data is estimated from the expenditure of individuals on a particular marine recreation activity (Prof. Kerry Turner, University of East

[102] Potts T, Burdon D, Jackson E, Atkins J, Saunders J, Hastings E, Langmead O., 2014. Do marine protected areas deliver flows of ecosystem services to support human welfare? *Marine Policy* 44; 139–148.

Anglia, pers. comm.). Only one study, by Lawrence[103], has a value of a change in the condition of the marine environment which might reflect the changes expected from MPAs. The other studies estimate the total expenditures on activities, and therefore only give an indication of the scale of the values which might change due to the impacts of management measures.

7.4.10 The lack of published valuation studies showing the effects of MPA management on marine nature-based recreational activities found in the UK (or similar locations) is a limitation in understanding what impacts the proposed management scenarios will have on recreational users. This in turn restricts the ability to identify socio-economic benefits from increased recreation activity as a result of management of the sites.

7.4.11 Evidence from the socio-economic monitoring of MPAs[104] suggested that a number of tourism and recreation initiatives were under development following the designation of MPAs. However, as with impacts on the fishing sector, it is too early for the socio-economic consequences of these initiatives to be identified.

7.4.12 It should be noted that any socio-economic benefits associated with recreation and tourism will occur in coastal, often remote communities. These communities may be the same as those where many of the costs identified in Section 6 occur.

Supporting Services

7.4.13 Supporting services are perhaps the most critical set of services provided by features in MPAs. Supporting services underpin all other ecosystem services, and therefore few studies are able to extract the contribution and therefore value of each ecosystem process. Valuing supporting ecosystem services brings a significant risk of double-counting, as they support the provisioning, regulating and cultural services from MPA sites discussed above. However, not valuing supporting services also brings a risk of under-valuing benefits if MPA management measures increase supporting services that give rise to final ecosystem services outside site boundaries, and these values are not captured because the available evidence is applied only to changes in final services inside the boundaries.

Total Economic Value

7.4.14 As well as limited evidence on the value of different ecosystem services, there are studies that attempt to estimate the total value of the protection of the marine environment. They are not directly relevant to the value of the proposed management scenarios being considered, as they generally relate to the

[103] Lawrence, K.S. (2005) Assessing the value of recreational sea angling in South West England. *Fisheries Management and Ecology* 12: 369–375.

[104] Marine Scotland Science, 2017. Scotland Marine Protected Areas Socioeconomic Monitoring. 2016 Report. Marine Analytical Unit, Marine Scotland Science, Scottish Government. Available online at http://www.gov.scot/Resource/0051/00514589.pdf. Accessed 19 April 2018.

existence of marine protected areas, rather than the introduction of management measures within existing sites.

7.4.15 An international study by Brander *et al.*[105] concluded that the benefits to people of expanding MPAs generally outweighed the costs. They considered the benefits of protection based on a meta-analysis of values. Their meta-analysis function could be used to estimate the benefits of the Scottish MPA network, but not of the proposed management scenarios being assessed.

7.4.16 A study by Gubbay[106] reviewed the evidence for benefits of MPAs set up for the conservation of marine biodiversity. They found some direct evidence that MPAs can protect and enhance ecosystem services comes from situations where habitats and species protected by MPAs are known to provide specific services. They concluded that highly protected MPAs lead to overwhelming positive effects on biodiversity (i.e. higher densities, biomass, size and diversity of certain species or groups of species). There is some evidence of positive species community effects such as greater complexity of food webs and increased primary and secondary productivity in MPAs as a consequence of protection.

7.4.17 McVittie and Moran[107] derived a primary estimate of benefits from the implementation of the nature conservation measures in the draft Marine Bill, specifically, Marine Conservation Zones (MCZs). They identified UK households' aggregate willingness to pay (WTP) of £487 million to £698 million per year. This figure represents a total economic valuation for the MCZ provisions. Due to the nature of the MCZ outcomes, it is suggested that a high proportion of this value will be non-use value. However, the data did not allow the study to categorically isolate this component of value.

7.4.18 A median value for halting the loss of marine biodiversity (which includes, but is a wider objective than MCZ provisions) had an aggregate UK value of £1,171 million per year. This value is based on median estimates, and is recommended as it avoids the influence of extreme values and represents the amount that 50% of respondents would be willing to pay.

7.4.19 The values generated within this research were based on the best *ex ante* assessment of the anticipated environmental gains from the UK Marine Bill Marine Nature Conservation Zones, using a hypothetical network scenario. Because of uncertainty, there is potential for disparity between the policy benefits estimates presented here and what is actually realised as the policy is implemented. It is also important to note that no assumption has been made for the timescale over which these benefits arise.

[105] Brander *et al.,* 2015. The benefits to people of expanding Marine Protected Areas. IVM Institute for Environmental Studies.

[106] Gubbay, S., 2006. Marine Protected Areas. A review of their use for delivering marine biodiversity benefits. English Nature Research Reports, No 688.

[107] McVittie, A., & Moran, D., 2008. Determining monetary values for use and non-use goods and services: Marine Biodiversity–primary valuation. Final Report to Defra.

7.4.20 It is interesting to note that the average values per household for halting loss of, or increasing, UK marine biodiversity in the McVittie and Moran study were lower in Scotland than in England or Wales. Nevertheless, the average household values in Scotland were significant and positive. Also, these values relate to average country household values for all UK waters, implying that English and Welsh households will value improvements in biodiversity in Scottish waters. There is also more general economic evidence of the Scottish populations' positive willingness to pay to conserve designated marine sites[108].

7.4.21 The extent to which the non-use values identified in the McVittie and Moran study are relevant to the proposed management scenarios in MPAs is related to the contribution that the measures will make to halting marine biodiversity loss. As a result, the site assessments in this study mainly identify moderate non-use values for the MPAs, with a low-moderate level of confidence. For the four sites, there are charismatic species and features that contribute to marine foodwebs, so the non-use value is assessed as moderate-high.

7.4.22 In large part, this conclusion is due to the uncertainties in how ecosystem services will change with respect to management scenarios. The assessment of benefits has focussed on the changes to ecosystem services that are expected to result from the proposed management scenarios. While the sites undoubtedly support a considerable range and value of ecosystem services, evidence on the baseline contribution of the site features to these ecosystem services, and on the expected nature of these changes in scientific or economic terms, is extremely sparse. As a result, the assessment of changes in ecosystem services at individual sites (see Table 9a in Site Reports, Appendix C) is uncertain.

7.5 Conclusions

7.5.1 The assessment of benefits has focussed on the changes to ecosystem services that are expected to result from the proposed management scenarios. While the sites undoubtedly support a considerable range and value of ecosystem services, evidence on the expected changes to ecosystem services is extremely sparse. As a result, the assessment of changes in ecosystem services at individual sites (see Table 9a in Site Reports, Appendix C) is highly uncertain.

7.5.2 The range of valuation evidence reviewed above gives indications of which ecosystem services that are impacted by management measures may be valuable to society. Consideration of different groups of services does not produce any valuation data that can be used with confidence to value the changes expected from sites. The uncertainty associated with the quantification of ecosystem services, as reflected in the evidence reviewed above, reinforces

[108] Jacobs, 2004. An Economic Assessment of the Costs and Benefits of Natura 2000 Sites in Scotland. Report to Scottish Government.

the necessity for a largely qualitative approach to the assessments of benefits at a site level.

7.5.3 The potential direct and indirect impact on GVA is a reduction between £0 (lower estimate), £2.1 million (intermediate estimate) and £4.2 million (upper estimate) over the study period (present value over 20 years, 2019 prices), associated with potential reductions in output from commercial fishing, which may have knock-on impacts on the fish processing industry. This is lower than the estimated non-use values of the sites in Kenter *et al*.[109] identified in Section 8 which assess:

- the benefits of designating each site as several £millions, with a total of over £20 million; and
- the benefit of implementing the proposed management scenarios as at least £5 million in total for the four sites.

7.5.4 However, it should be noted that there is a high level of uncertainty in using these values.

[109] Kenter, J.O., Bryce, R., Davies, A., Jobstvogt, N., Watson, V., Ranger, S., Solandt, J.L., Duncan, C., Christie, M., Crump, H., Irvine, K.N., Pinard, M. & Reed, M.S., (2013). The value of potential marine protected areas in the UK to divers and sea anglers. UNEP-WCMC, Cambridge, UK.

8 Combined and Cumulative Impacts

8.1 Marine Activities

Combined Cost Impacts by Site

8.1.1 The combined quantified cost impacts per site are presented in Table 41. This presents information for cost impacts that are not expected to result in impacts on GVA. Table 42 presents direct and indirect GVA impacts for all sectors where an impact on output is anticipated. In this case, the only sector where combined or cumulative impacts on GVA are anticipated is commercial fisheries, the justification for this is included below.

8.1.2 The cost impacts that are not expected to result in GVA impacts (Table 41) are very variable between sites and scenarios, reflecting the different activities that occur within each site and the differing requirements for management. The total quantified cost impacts for the pMPAs (present value over 20-year assessment period at 2019 prices) are estimated to range between £0.6 million (lower estimate) up to £10.9 million (upper estimate) with a more likely estimate of £0.8 million (intermediate estimate)..

8.1.3 In addition to these quantified cost estimates, it should be recognised that it has not been possible to quantify a range of other potential cost impacts and the figures presented therefore represent a partial assessment of cost impacts.

Table 41 Potential cost impacts by site for all sectors (present value of total costs over 20 years, £000s, 2019 prices)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	72	134	642
Sea of the Hebrides pMPA	175	344	451
Shiant East Bank pMPA	4	4	319
Southern Trench pMPA	118	118	9,305
Military activities (national assessment)	195	195	195
Total	**565**	**796**	**10,913**

8.1.4 The total direct GVA impacts on commercial fisheries for the pMPAs are estimated to range between £0 (lower estimate) up to £ 2.9 million (upper estimate) with a most likely estimate of £1.5 million (intermediate estimate) (present value over assessment period at 2019 prices). These impacts arise as a result of reduced landings from areas in pMPAs where fishing effort would be restricted under the proposed management scenarios for each site.

8.1.5 Considering direct and indirect GVA impacts (Table 42), the total impacts on commercial fisheries for the new MPAs are a reduction between £0 (lower

estimate), £2.1 million (intermediate estimate) and £4.2 million (upper estimate) over the study period. Again, these values are the present value of total impacts over 20 years.

Table 42 Potential GVA impacts by site for all sectors (present value of direct and indirect GVA over 20 years, £000s, 2019 prices)

Site	Estimate		
	Lower	Intermediate	Upper
North-East Lewis pMPA	0	N.D.	N.D.
Sea of the Hebrides pMPA	0	23	36
Shiant East Bank pMPA	0	253	424
Southern Trench pMPA	0	1,857	3,714
Total	**0**	**2,133**	**4,174**
N.D. = Value cannot be disclosed. Where data represent fewer than 5 individuals/vessels/companies, their value cannot be disclosed for data protection reasons.			

Combined Cost Impacts by Activity

8.1.6 Table 43 summarises the non-GVA quantified costs to activities associated with the designation of new pMPAs. Cost impacts vary considerably between activity and between scenarios, reflecting differing extents of interaction between activities and features proposed for designation and the possible range of management scenarios required to support achievement of site conservation objectives. It should also be recognised that it has not been possible to quantify some potential cost impacts in this study, such as the cost of uncertainty and delays in the licensing process.

8.1.7 Non-GVA costs across all sectors (present value over 20-year assessment period at 2019 prices) are estimated to range between £0.6 million (lower estimate) up to £11 million (upper estimate) with a most likely quantified estimate of £0.8 million (intermediate estimate). Under the intermediate scenario, the largest costs are estimated to be experienced by the finfish aquaculture sectors. This reflects the potential requirement for finfish aquaculture farms to upgrade acoustic deterrent devices (ADDs) at end of life.

8.1.8 Under the upper estimate, the largest costs are estimated to be experienced by the oil and gas, energy, power interconnectors, telecoms, and carbon capture and storage sectors. This relates principally to potential restrictions on when survey activities can be undertaken and subsequent additional weather downtime costs.

Table 43 Potential total cost impacts by sector (present value of total costs over 20 years, £000s, 2019 prices)

Site	Estimate		
	Lower	Intermediate	Upper
Aquaculture – finfish	39	269	407
Aquaculture – shellfish	76	76	76
Carbon capture and storage	5	5	554
Coastal defence and flood protection	49	49	49
Energy generation	0	0	548
Military activities	195	195	195
Oil and Gas	0	0	7,502
Ports and harbours	179	179	182
Power interconnectors and transmission lines	6	6	1,066
Recreational boating	0	0	1
Shipping	0	0	1
Telecom cables	16	16	331
Tourism	0	0	0
Water sports	0	0	0
Total	**565**	**796**	**10,913**

8.1.9 Table 44 presents information on potential direct and indirect GVA impacts, where a change in the value of output (landings) may occur for the commercial fisheries sector. The estimated combined impact on direct and indirect GVA across all pMPAs for the commercial fisheries sector varies from £0 (lower estimate), £2.1 million (intermediate estimate) and £4.2 million (upper estimate) (present value, costs discounted over the 20-year assessment period, 2019 prices).

Table 44 Potential total GVA impacts by sector (present value of total direct and indirect GVA impact over 20 years, £000s, 2019 prices)

Site	Estimate		
	Lower	Intermediate	Upper
Commercial fisheries	0	2,144	4,187
Total	**0**	**2,144**	**4,187**

Significance of Combined and Cumulative Impacts on Marine Activities and Regions (commercial fisheries, energy generation – offshore renewables, ports and harbours)

8.1.10 This section considers the significance of economic impacts to marine activities and geographic areas taking account of the relative scale of the impacts both on their own and in combination with other marine initiatives, in particular:

- Development of offshore wind farms based on the currently proposed, consented, contracted and under construction wind farms[110];
- Potential future offshore renewables development under the draft plan for wave and tidal energy developments in Scottish waters[111], and the current Areas of Search (AoS) for offshore wind (noting that these will be superseded by new Draft Plan Options in January 2019);
- The 30 Nature Conservation MPAs designated in 2014[112];
- The implemented phase 1 measures in inshore MPAs and SACs[113,114];
- The impact assessment of the draft (now proposed) SPAs; and
- The SEIA of proposed phase 2 fisheries management measures in inshore MPAs and SACs[115].

8.1.11 The assessment of management measures for priority marine features (PMFs) is ongoing and is yet to be fully consulted upon. In consequence, it is not possible at this stage to determine whether there may be cumulative effects arising from interactions between the designation of four additional pMPAs and these proposals. This possibility will be assessed by the forthcoming SEIA for the PMF fisheries management measures.

8.1.12 For many of the marine activities, the potential cost impacts associated with the designation of pMPAs are minor and will not be significant in their own right or in combination with other initiatives. The activities identified below may experience more significant cost impacts under the intermediate and / or upper scenario as a result of designation of the pMPAs and the cumulative impacts on

[110] Marine Scotland, 2011. Blue Seas – Green Energy: A Sectoral Marine Plan for Offshore Wind Energy in Scottish Territorial Waters. Part A – The Plan.

[111] Marine Scotland, 2013. Planning Scotland's Seas: Sectoral Marine Plans for Offshore Wind, Wave and Tidal Energy in Scottish Waters - Consultation Draft, July 2013.

[112] Marine Scotland, 2013. Planning Scotland's Seas: 2013 - The Scottish Marine Protected Area Project – Developing the Evidence Base tor Impact Assessments and the Sustainability Appraisal Final Report.

[113] It is recognised that the data used (2012-2016) do not fully take account of changes to fishing patterns as a result of phase 1 MPA measures, therefore it is included in this in-combination assessment and not considered a sunken cost. Due to this the assessment may, therefore under/overestimate impacts.

[114] Marine Scotland Science, 2017. Scotland Marine Protected Areas Socioeconomic Monitoring. 2016 Report. Marine Analytical Unit, Marine Scotland Science, Scottish Government. Available online at http://www.gov.scot/Resource/0051/00514589.pdf. Accessed 19 April 2018.

[115] Marine Scotland, 2018. Proposed Inshore MPA/SAC Fisheries Management Measures – Phase 2. Socio-Economic Impact Assessment. October 2018. Report prepared by ABPmer & eftec for the Scottish Government.

these sectors and on geographic areas have therefore been considered in more detail:

- Commercial fisheries
- Aquaculture - finfish
- Oil and gas
- Power interconnectors
- Energy generation - offshore renewables
- Carbon capture and storage
- Telecom cables

8.1.13 There is potential for cumulative effects on commercial fisheries, particularly with the management of other designations and the potential for restriction on fishing areas due to renewable energy developments. There is potential for the restriction on fishing activity within Southern Trench pMPA under the proposed management scenarios to combine with restrictions on fishing activities within the other designations in the area (Dornoch Firth & Morrich More SAC and Moray Firth SAC, Moray Firth pSPA) and potential exclusions from areas associated with the offshore wind developments currently proposed or under construction in the Moray Firth (Beatrice, East Moray and West Moray offshore wind farms) (Figure 3). In addition, there are several offshore wind Areas of Search (Figure 3) identified within the Moray Firth and further offshore, which, if they were to be developed may also restrict fishing activity in the region. The Areas of Search are early proposals and likely to be updated in the near future to Development Plan Option areas. The scenarios being considered are for 2, 4 and 8GW of offshore wind to be developed at national level, whilst the Areas of Search have the capacity to accommodate 130GW. There is therefore considerable uncertainty in the location, scale and timing of development within these areas; some areas may not be developed at all, and it is unlikely that large areas within the Areas of Search will be developed during the study period.

8.1.14 There is potential for in-combination impacts on *Nephrops* and scallop fisheries in the Moray Firth between the Southern Trench pMPA and the proposed and under construction windfarms, the assessments for the three offshore windfarm sites all identify potential impacts (including cumulatively) on scallop, squid, whitefish and *Nephrops* fisheries. Moray East identifies at worst a minor / moderate impact on scallop and squid fisheries, and all three note that the scallop and squid fisheries are of higher importance than any *Nephrops* fisheries within their study areas. Conversely, the pMPAs have lower impacts related to scallop and squid fisheries, with higher impacts on *Nephrops* fisheries. Therefore, whilst there is potential for in-combination effects on fisheries, this is considered to be minor, as the fisheries that are most affected between the pMPA and offshore wind areas are different (*Nephrops* fisheries in Southern Trench, and scallop and squid fisheries in the offshore windfarms).

8.1.15 No specific management measures are currently identified for the Moray Firth pSPA. However, the impact assessment for the dSPAs assessed a potential impact on demersal trawls, and to a lesser extent, dredges.

8.1.16 Potential management measures have been identified for the Dornoch Firth & Morrich More SAC and Moray Firth SAC. These management measures have been identified as having an impact on *Nephrops* and scallop fisheries, which have the potential to combine with impacts from the proposed management scenarios being assessed for the Southern Trench pMPA.

8.1.17 Table 45 shows the estimated annual loss of landings associated with the intermediate scenario management measures at Dornoch Firth & Morrich More SAC and Moray Firth SAC, Moray Firth pSPA and the Southern Trench pMPA. There is potential for an in-combination effect on under-12m and over-12m demersal trawlers, likely to be *Nephrops* trawlers. This is, in total, a loss of £395k landings annually. There may be some double-counting between the impacts estimated for Dornoch Firth & Morrich More SAC and Moray Firth SAC with the Moray Firth pSPA (which overlap each other), and the overall cost impacts may be lower. If effort is displaced from the areas, rather than being lost, this would result in concentration of effort in the areas that remain open to fishing, which could lead to reductions in catch per unit effort, changes to the cost profile of vessels, and potential for increased gear/vessel conflict.

8.1.18 In addition to the direct cost associated with loss of landings to the commercial fishing industry, fish processing industries have the potential to be impacted by reductions in throughput due to the combined management scenarios, as shown in Table 45. There are small amounts of in-combination impacts, however these are considered to be minor in the context of the fish processing industry.

8.1.19 The Coll and Tiree pSPA and Rum pSPA overlap with the Sea of Hebrides pMPA. No combined impacts are expected as the impacts from Sea of Hebrides pMPA are minimal.

Table 45 Annual loss of landings in intermediate management scenarios at Dornoch Firth & Morrich More SAC and Moray Firth SAC, Moray Firth pSPA and Southern Trench pMPA

Sector/gear	Dornoch Firth & Morrich More SAC and Moray Firth SAC	Moray Firth pSPA	Southern Trench pMPA	Totals
Over-12m vessels	Annual Loss of >12m landings (£000s)*:			
Demersal trawls	0.5	65.7	227.7	293.9
Mechanical and suction dredges	29.1	11.5	1.6	42.2
Under-12m vessels	Annual Loss of <12m landings (£000s):			
Demersal trawls	20.7	75.8	4.7	101.2
Mechanical dredges	5.2	2.7	0.0	7.9
Total all vessels	**55.5**	**155.7**	**234.0**	**289.5**
* For Moray Firth pSPA, the values relate to >15m landings ** For Moray Firth pSPA, the values relate to <15m landings				

8.1.20 The costs calculated to impact on finfish aquaculture are associated with the replacement of ADDs with cetacean / basking shark appropriate devices (intermediate estimate) or anti-predator nets (upper estimate). There are not considered to be any further pathways where the future management of other designated sites, or the development of offshore renewables would combine to an additional cost to the industry, at this point.

8.1.21 Costs to the oil and gas, power interconnectors, energy generation (offshore renewables), carbon capture and storage, and telecom cable sectors are mostly, under the upper estimate, associated with seasonal restrictions on survey within pMPAs associated with basking shark, Risso's dolphin and minke whale. This survey restriction is not a measure that will increase in-combination effects with either the management of other designated sites or with renewable energy developments.

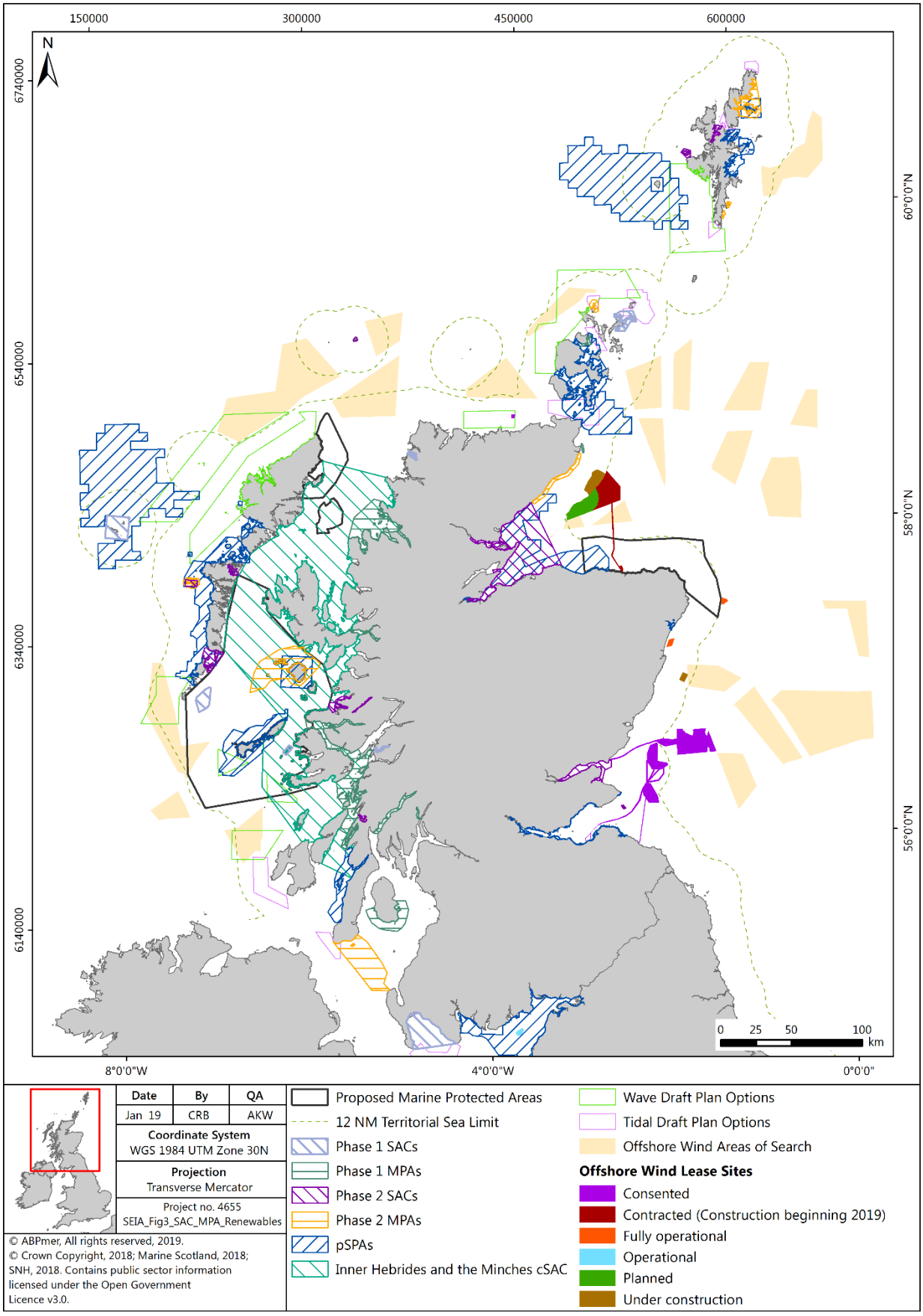


Figure 3 Spatial information on MPAs, SACs and SPAs and sectors with potential for cumulative effects on commercial fisheries

8.2 Social Impacts (commercial fisheries)

8.2.1 Three of the sites are not expected to have significant social impacts, and therefore the combined and cumulative impacts of the four sites are likely to be similar to those identified for the one site that does have social impacts — Southern Trench. The social impacts for Southern Trench pMPA are assessed as low, therefore these impacts are not re-assessed collectively.

8.3 Public sector

8.3.1 The estimated total costs to the public sector, currently assumed to be centralised and therefore mostly attributed to SNH and MS, are presented in Table 24 and Table 25. Potential future monitoring costs comprise the majority of the total public-sector costs, spread across all MPAs. Additional costs may be associated with the preparation of Management Schemes and in determining and advising upon licence applications within or near to the proposed sites.

8.3.2 The total public sector costs under the intermediate scenario were estimated at around £1.3 million (present value over 20 years (2019 to 2038) at 2019 prices), of which approximately 80% was associated with future monitoring costs of pMPA features.

8.3.3 Should more local management of the sites be pursued, this is considered unlikely to materially change the costs to the public sector but would redistribute costs across a wider range of regulators and authorities.

8.4 Potential Benefits

8.4.1 Treating marine protected areas as a collection of individual and separate features providing separate ecosystem services potentially ignores any network effects that could occur from a set of MPAs. A number of adjacent marine reserves may demonstrate network effects, i.e. the benefit from the networks may be greater (or less) than the sum of the benefits from the individual MPAs. Some MPAs will protect replicates of habitats and features, and they may be connected through larval dispersal, thus making the MPA network more resilient to impacts. These effects are potentially of great importance in assessing the benefits of management measures in marine protected areas because of the lack of barriers and mobility of species.

8.4.2 Kenter *et al.*[116] examined the value of creating a network of marine protected areas in the UK using two methods: travel cost method for visitor values, and contingent valuation to measure willingness to pay. Both methods were used to value four designation and management scenarios. The study was based on

[116] Kenter, J.O., Bryce, R., Davies, A., Jobstvogt, N., Watson, V., Ranger, S., Solandt, J.L., Duncan, C., Christie, M., Crump, H., Irvine, K.N., Pinard, M. & Reed, M.S., (2013). The value of potential marine protected areas in the UK to divers and sea anglers. UNEP-WCMC, Cambridge, UK.

Scottish search areas, so covered versions of the proposed sites (but some boundaries have changed: e.g. 'Skye to Mull is similar to the proposed 'Sea of Hebrides').

8.4.3 The Kenter *et al.* study gives a value for site designation only, without any management measures being implemented, and designation with different fisheries management measures. The management measures examined overlap, but are not the same as, those now proposed for the four MPAs. The study results are translated to suggest the following values, in 2019 prices, for the total value of proposed management measures. The 'with management' values are based on the 'no dredging or trawling' scenarios (Table 45)[117].

Table 45 Estimated valuation of site designation and protection (£ millions, 2018 prices)

Site	Estimate of total economic value (lower bound)	
	Designation only (£ million)	Designation and management (£ million)
North-East Lewis pMPA	5.29	6.04
Sea of the Hebrides pMPA	8.63	10.57
Shiant East Bank pMPA	5.61	6.36
Southern Trench pMPA	7.98	9.17

8.4.4 These figures suggest values of the order of magnitude of millions of pounds for the protection provided by the proposed designation and management of each site. For all sites, this scale of values is significantly larger than the expected negative impacts on fisheries at the sites under the upper estimate.

8.4.5 For three sites, the additional benefits of fisheries management measures (the difference between the two columns) is larger than the expected negative impacts on fisheries at the sites under the upper estimate. For the Southern Trench, the expected negative impacts on fisheries are of a similar scale to the additional values of management measures derived from Kenter *et al*.

8.4.6 A comparison can be made between the values for designation and management and commercial fisheries costs. The total non-use benefits of designating the sites are estimated at £28 million, and the sum of estimated additional non-use benefits of fisheries management measures are £4.6 million. The estimated total fisheries costs are £2.1 million (intermediate estimate) and £4.2 million (upper estimate) over 20 years (present value, 2019 prices) (see Table 13), which equates to a loss in the value of landings of £3.9 million to £7.7 million over 20 years (present value, 2019 prices). However, this comparison has significant uncertainties.

[117] These represent 'one-off' values that people associate with protection in perpetuity. In practice it is not always clear what timescale people might be thinking of when they express these values. They are not annual values, and are broadly comparable to the 20 year costs.

9 Limitations and Uncertainties

9.1 Overview

9.1.1 All of the estimates of costs and benefits are subject to significant uncertainties. Limitations and uncertainties in relation to marine activities, social impacts, public sector costs and environmental impacts are described below.

9.2 Marine Activities

9.2.1 Uncertainties in the location and nature of future activity in the marine environment also introduce an uncertainty in the estimation of costs and benefits. For example, future finfish and shellfish aquaculture developments have been estimated based on industry advice and then allocated across pMPAs. For other sectors such as offshore renewables and oil and gas, the location and scale of future development is particularly uncertain and the assessment has focused on planned and proposed development. Given that further development proposals are likely to come forward within the time period of the IA (2019 to 2038), there is potential that costs to these sectors will be significantly underestimated. Similar uncertainties relate to future trends in ongoing activities such as commercial fishing (assumed landings values remain constant over the assessment period). Such assessments are therefore based on a significant degree of speculation about future levels of activity and are thus inherently uncertain.

9.2.2 As identified in section 3 and Appendix C, it has not been possible to estimate the cost of potential consequential impacts associated with designation, for example, the costs of delays to consenting processes or costs associated with reduced investor confidence. It is recognised that these costs, where they occur, may be significant. However, it is not possible to predict whether or for which sites, such impacts may arise.

9.2.3 It is recognised that the actual costs that may be incurred by specific activities within individual sites may be higher or lower than the ‘average’ values generated within this assessment. In addition, the consequential impacts in remote or fragile communities may have the potential to be greater than the estimates presented in this assessment.

9.2.4 For commercial fisheries, spatial resolution of data on under-12 m vessels is not sufficient for an accurate assessment of cost impacts to this fleet segment. Scotmap data, which relate to under-15 m vessels, were used to pro-rata the ICES rectangle landings value for under-12 m vessels to the management areas. This assumes that the pattern of activity of under-12 m vessels currently is similar to that for under-15 m vessels in 2007. If the distribution of effort differs significantly between these two vessel size groups, or has changed over time, this may over- or under-estimate the value of landings affected for under-

12 m vessels. Additionally, Scotmap was based on a survey which had low coverage in some regions.

9.2.5 VMS pings occur at least every two hours, and therefore do not provide a complete picture of fishing activity. However, by using data over a five-year period this limitation is minimised. The process of averaging landings data across pings may result in landings values being over- or under-estimated for individual pings.

9.2.6 The classification of gear types relies on the information reported in logbooks. Some gears may be wrongly classified, in particular mechanical dredges may be classified as mechanised (suction) dredges.

9.2.7 The extent to which displacement of fishing activity will occur (rather than loss of the value of landings), and the nature of displacement (areas or gear types to which effort might be displaced) is uncertain. The knock-on impacts in terms of environmental impacts, impacts on vessels affected and impacts on other vessels, are also uncertain. For the intermediate and upper estimates, it has been assumed that the value of landings affected is lost. However, in practice it is likely that at least part of the effort would be displaced, and this could result in additional environmental impacts, impacts on the vessels displaced, and on other vessels.

9.2.8 As the value of future landings cannot be forecast, it is assumed that the value of landings are constant over time. The average value of landings per year estimated for each site is therefore assumed to be the same in each of the 20 years covered by the impact assessment. In reality, it is likely that the value of landings in each site would fluctuate over time, depending on regulations, quotas, and environmental influences, and hence the estimated loss in landings may underestimate or overestimate the true future value of landings. As the GVA and employment estimates are based on the value of affected landings the same limitation applies.

9.2.9 Fishing patterns may have changed compared to the period from which data were used for the assessment (2012–2016). In particular, phase 1 MPA management measures were introduced in 2016 and therefore are not fully reflected in the data used. However, because the phase 1 measures do not generally affect the same gear types in the same areas, this effect is expected to be low. Similarly, displacement of fishing effort resulting from the construction of Beatrice windfarm will not be fully captured in the data used for the assessment.

9.2.10 The multipliers used to estimate the indirect GVA impacts and the direct plus indirect employment effect, which could be generated from the estimated reduction in the value of landings, relate to ‘Marine Fishing and Freshwater Fishing’ and not the specific gear types affected. They may, therefore, underestimate or overestimate the impacts. The multipliers – which are national multipliers – have been applied at the site level and regional/port level to estimate the economic impacts by site and by region/port. Local and regional

multipliers are not available and hence the application of national multipliers may overestimate or underestimate the size and geographical distribution of impacts. Finally, application of the multipliers also assumes that a reduction in output is similar to a change in final demand and that there is no rise in the price of fish to offset the reductions in the value of landings.

9.2.11 The combined assessment poses particular challenges owing to the complexity of such assessments and the limited scientific understanding of impacts. Within this study, combined effects have generally been assessed as the sum of the individual impacts on individual sites. The assessment of combined benefits is subject to the same limitations as those identified for the site assessments. However, at this scale, additional evidence on the network value of MPAs is relevant. For example, after careful analysis to identify additional impacts from designation, there is little evidence to suggest diminishing returns from designating the suite of proposed sites. Furthermore, the sites can cumulatively contribute to the resilience of marine ecosystem services in a way that is greater than the sum of their parts, but there is little if any quantified evidence available to support this.

9.3 Social Impacts

9.3.1 The main potential social impacts identified within the assessment relate to impacts on the commercial fishing sector. Given the range relating to commercial fishing economic impacts identified across the scenarios analysed, the social consequences of the proposed management scenarios are also similarly uncertain.

9.3.2 However, the worst-case impacts identified under the upper scenario are relatively small, and are considered unlikely to have significant social effects. While there are uncertainties in the exact extent of these impacts, there is reasonable confidence in the general conclusion that they are unlikely to be economically or socially significant.

9.4 Public Sector

9.4.1 Costs on the public sector are uncertain and may be higher or lower than estimated. The costs include additional regulatory and advisory costs associated with licensing decisions are dependent on the number of licence applications that are brought forward, and this is subject to the same uncertainties as the cost impacts on relevant marine activities. The scope, scale and frequency of monitoring requirements for mobile species and benthic habitats may also significantly affect the estimates of public sector costs for monitoring.

9.5 Environmental Impacts

9.5.1 In general, there is moderate uncertainty on the extent of ecosystem service impacts, although this varies across services and sites. There is high uncertainty in the monetary valuation of these benefits, and robust values are not available to support cost-benefit analysis. See Section 7 for more detail.

10 Next Steps

10.1.1 The consultation on the SEIA is now open, along with the accompanying SEA Environmental Report and Sustainability Appraisal. Views and opinions on this are now invited and should be provided by 30 August 2019.

10.1.2 Please respond to the consultation online at: https://consult.gov.scot/marine-scotland/four-new-marine-protected-areas

10.1.3 Following the consultation period, the responses received will be analysed, and a Post-Adoption Statement will be prepared. The Post-Adoption Statement will explain how issues raised in the assessments, and associated views in response to the consultation, have been addressed.

10.1.4 If you have any enquiries please contact: Marine_Conservation@gov.scot

10.1.5 Or send your inquiry by post to:

pMPA Consultation
Scottish Government
Marine Planning and Policy Division
Area 1-A South
Victoria Quay
Edinburgh
EH6 6QQ

Appendix A Sector Context, Assumptions and Assessment Methods

See separate document: Appendix A - Sector context

Appendix B Public Sector Costs

This appendix provides the assumptions used to assess the impacts of pMPAs on the public sector. The assumptions are reviewed in groupings of costs, as follows:

- Management schemes;
- Statutory instruments;
- Voluntary measures;
- Site monitoring;
- Compliance and enforcement;
- Promoting public understanding; and
- Regulatory and advisory costs associated with licensing decisions.

B.1 Marine Management Schemes

As part of the process of designation, 'Conservation Objective and Advice to Support Management' documents will be developed for each new MPA. Amongst other things, these set out the preferred management option and how this could be delivered. These documents represent a sunk cost as the work will largely be completed ahead of the decision to designate individual sites. For many sites the document is likely to provide a sufficient basis for coordinating management efforts. However, for sites where a large number of activities may be occurring, or there is overlap with other MPAs, it may be necessary to develop a more formal Marine Management Scheme (for MPAs). These are likely to be developed on a regional basis, and pilot regional MPA management plans are being developed through the Interreg-funded Marine Protected Area Management and Monitoring project (MarPAMM). These management plans will aim to deal with the needs of regulators and communities in terms of providing guidance and information needed to help them effectively manage the MPAs in their region.

For the purposes of this assessment, it has been assumed that a management scheme will be required for certain inshore sites within 6nm where there are multiple activities taking place over a significant proportion of the site. On this basis three of the MPA sites have been tentatively identified as potentially requiring Marine Management Schemes:

- Sea of the Hebrides;
- North-east Lewis; and
- Southern Trench.

The cost associated with preparing a Marine Management Scheme has been assumed to be £27,800 (at 2019 prices) per site based on the estimate of £23,000 at 2009 prices provided in RPA and ABPmer[118]. It is assumed that that these Schemes are developed in 2019 and 2020 with the costs split equally across these 2 years.

[118] RPA & ABPmer (2009). Full Regulatory Impact Assessment: Scottish Marine Bill

B.2 Statutory Instruments

Several different mechanisms may be used to restrict or regulate works or activities potentially affecting new MPAs:

- Marine Conservation Orders (under the Marine (Scotland) Act 2010) for new MPAs;
- Fisheries management measures within 12NM under the Inshore Fishing (Scotland) Act 1984;
- Amendments to fishing licences; and
- Fisheries management measures beyond 12NM under the Common Fisheries Policy.

Marine Conservation Orders

Marine Conservation Orders (MCOs) may be required to regulate activities that take place within a designated MPA where and when required. MCOs are provided for under the Marine (Scotland) Act and are therefore applicable only to inshore sites. They might be required to prohibit or restrict certain activities such as entry into a site, anchoring vessels, killing, taking etc. animals or plants, depositing material or damaging the seabed. The cost associated with the making of such Orders has been assumed to be £4,200 in 2019 prices, being the uprated cost of the mid-range of the estimate provided in RPA & ABPmer[119] (£3,500 at 2009 prices).

Marine Scotland has indicated that the main activity that MCOs could be used to manage is commercial fisheries. However, such management is likely to be taken forward under the Inshore Fishing (Scotland) Act for sites within 6NM (see below). Only Southern Trench pMPA extends beyond 6NM and could require an MCO to implement management measures under the intermediate and upper scenarios.

Inshore Fisheries Management Measures

Should fisheries management measures be required in inshore waters, it is likely that these will be pursued under fisheries legislation rather than through MCOs. The Inshore Fishing (Scotland) Act 1984 enables Ministers to establish spatial management measures within 6NM through Orders which may prohibit certain gear or vessel types, the targeting of particular species and the time periods for which such prohibitions apply.

For the purposes of this assessment, it has been assumed that an Order will be required for each MPA for which new fisheries management restrictions are identified as being required. The cost associated with the making of such Orders (or modifying existing Orders) has been assumed to be £4,200 in 2019 prices, being the uprated cost of the mid-range of the estimate provided in RPA and ABPmer[120] (£3,500 at 2009 prices).

[119] RPA & ABPmer (2009). Full Regulatory Impact Assessment: Scottish Marine Bill

[120] RPA & ABPmer (2009). Full Regulatory Impact Assessment: Scottish Marine Bill

It has been assumed that there is a requirement for the development of fisheries management orders at all sites under the intermediate and upper scenarios, except Southern Trench which is assumed to be managed through an MCO, in line with potential restrictions on fishing activity identified in the proposed management scenarios.

Amendments to fishing licences

s197 of the Marine and Coastal Access Act 2009 as read with s158 of the Marine (Scotland) Act 2010 gives Scottish Ministers the power to amend the conditions of fishing licences to protect the marine environment within territorial waters (0-12NM). These can be used to apply similar restrictions to those applicable using the Inshore Fishing (Scotland) Act 1984.

Marine Scotland (pers. comm., 2013) has indicated that modifications to fishing licences is a minor administrative task (all fishing licences could be amended within 3 days by a single member of staff) and the costs of amending a proportion of fishing licences would therefore be absorbed within existing activity.

As a worst-case scenario, we have therefore assumed that the costs for implementing management measures would be those for the implementation of fishing orders and MCOs.

Fisheries management measures beyond 12nm under the Common Fisheries Policy

Where fisheries management measures are required in offshore waters (beyond 12NM) these would need to be pursued through the Common Fisheries Policy (CFP) in consultation with the European Commission. These measures, if approved, would control the activities of all fishing vessels. The measures could introduce spatial restrictions on gear types, the targeting of particular species and the time periods for which such prohibitions would apply.

Based on the management scenarios (Appendix D), there is potential for management measures under the CFP to be required for a small portion of STR, where it extends beyond 12NM, under the intermediate and upper scenarios.

There is, however, considerable uncertainty over the future likelihood of the UK relationship with the European Union, including with regards to the CFP. Therefore, it has not been considered appropriate to estimate costs associated with negotiations to develop CFP fisheries management measures.

B.3 Voluntary Measures

For some sites, it may be appropriate for public bodies to develop or promote voluntary measures to manage certain activities. This may be particularly appropriate for recreational activity in MPAs supporting marine mammal or basking shark features.

The cost associated with developing and publicising voluntary measures is uncertain, but considered likely to be similar to the costs of preparing Orders (assumed to be £4,200 at 2019 prices, being the uprated cost of the mid-range of the estimate provided

in RPA and ABPmer[121] (£3,500 at 2009 prices). It has been assumed that this cost is incurred in 2020 for relevant scenarios within each site.

It has been assumed that the promotion of existing or new voluntary measures is likely to be required at all sites, as reference is made to best practice under numerous sectors and all scenarios. Therefore, the cost has been assumed to be applied at all sites under all management scenarios.

Many organisations representing users of the sea already promote voluntary measures to minimise the environmental impact of their activities. The Royal Yachting Association and the British Marine Federation, for example, instituted the Green Blue programme for this purpose. In such cases existing mechanisms for publicising voluntary measures can be used.

B.4 Site Monitoring

The costs of site surveys to characterise new MPAs in advance of designation have been treated as sunk costs because the expenditure has already occurred or has been budgeted.

Following designation, there will be an ongoing requirement to undertake monitoring within MPAs, both to improve understanding of the distribution of features and to monitor the condition of features to assess achievement of the feature-specific conservation objectives.

The costs of monitoring individual MPAs will vary depending on the locations of the sites and types of features for which the sites are designated, with higher costs likely to be associated with surveys for offshore sites, owing to the requirement for larger vessels. For the purposes of this assessment, the following assumptions have been applied:

- Initial funding of £150k to inform the scope of future monitoring and set up monitoring programme[122];
- For the 3 MPA sites with marine mammal and/or basking shark features (North-east Lewis, Sea of Hebrides, Southern Trench) it is assumed that at least £54k per location will be needed every three years to support work being undertaken by interest groups working on these species within or close to the MPA proposals. This is a conservative estimate[123] as this is based on part of one site, and the actual cost of monitoring could be greater;
- For MPA sites with benthic habitat features (Shiant East Bank, Southern Trench), it is assumed that benthic surveys would be carried out as soon as possible after designation and every

[121] RPA & ABPmer (2009). Full Regulatory Impact Assessment: Scottish Marine Bill.

[122] As advised by SNH.

[123] SNH are providing funding of £54k over three years to carry out marine mammal surveys in part of one of the sites (SNH *pers. comm.*).

12 years thereafter at an estimated cost of £85k[124] per site per survey.

The monitoring cost assumptions are indicative and will depend on site prioritisation under the Scottish MPA Monitoring Strategy. Additional costs for marine mammal surveys may be required for robust monitoring for the sites, but there may be some efficiencies by combining with other marine mammal surveys. More realistic overall sums for future inshore benthic monitoring are currently being pursued by the UK and Devolved Administrations.

B.5 Compliance and Enforcement

Where management measures are necessary to support the achievement of conservation objectives for individual features within MPAs, a level of compliance and enforcement activity will be required. For licensable activities, this is likely to primarily entail scrutiny of monitoring returns provided by operators in fulfilment of conditions in their licences and in most cases is likely to impose only a minimal administrative burden on regulators. For example, in relation to finfish aquaculture, the requirement to adhere to best practice can be checked as part of SEPA's existing inspection programme.

For unlicensed activity, some additional site based monitoring could be required. For commercial fishing activity, Vessel Monitoring System (VMS) data will provide a good source of information on spatial activity for vessels over 12 metres in length. However, since management measures restrict certain gear types but not all gear types, some additional site-based inspection activity may also be required, although in the future, remote sensing technologies or high frequency VMS technologies may be able to be used to indicate gear types being deployed. Marine Scotland Compliance have three Marine Protection Vessels (MPV) that are deployed on fisheries enforcement activities in Scottish inshore and offshore waters. Marine Scotland Compliance (Marine Scotland, pers. comm., 2013) has indicated that potential additional inspection requirements for MPAs will be prioritised within existing resources and will not therefore lead to any significant increase in existing costs.

For vessels under 12 metres in length, it may be necessary to establish alternative compliance mechanisms, for example, using inshore VMS (iVMS) systems based on mobile phone technology, which have successfully been used to monitor compliance with spatial closures in Lyme Bay. The cost of acquiring and installing an iVMS device was around £1,200 in 2019 prices[125]. It is considered unlikely that MPA-specific requirements for the introduction of iVMS will be identified, as previous fisheries management measures for MPA sites in Scotland implemented in 2016 have not necessitated such systems. In addition, the Scottish Government has committed to implementing appropriate inshore fisheries monitoring by 2020 for vessels under

[124] These sites may require an offshore survey vessel, and may require infaunal sampling and drop-down video, therefore a cost of £85k per survey is assumed.

[125] UK Government (2018) Regulatory triage assessment for the consultation on the introduction of inshore Vessel Monitoring Systems for all licensed British fishing boats under 12 metres in length operating in English waters

12 m[126,127]. Therefore, the cost will not specifically be associated with the MPA network and as a result, it is not considered appropriate to record the cost of implementing iVMS against the MPAs.

For other types of unlicensed activity, it is unlikely that formal compliance monitoring will be required unless specific local issues arise. For MPAs, additional information on compliance is likely to be provided by members of the public.

B.6 Promoting Public Understanding

Once designated, a level of promotion of the MPAs and their management plans will be undertaken. This may take a variety of forms including provision of information via the internet, including within Marine Scotland Interactive, SNH Sitelink, and for inshore sites, local public education activity and possibly the provision of signage at key access points. The costs associated with these activities are generally considered to be part of normal corporate activity for Marine Scotland and SNH and for the purposes of this assessment it has therefore been assumed that no additional costs will be incurred.

B.7 Regulatory and Advisory Costs Associated with Licensing Decisions

Where licensed development is proposed in the vicinity of features protected within or adjacent to MPAs, developers may be required to provide an assessment of the potential impacts of the development on those features as part of their overall development application to meet legislative requirements.

For MPAs, under the Marine (Scotland) Act 2010 and Marine and Coastal Access Act 2009, where it is concluded that a proposed development is capable of affecting other than insignificantly a protected feature of an MPA, a more detailed assessment of the potential impact is required. This main assessment stage focuses on determining whether the potential development might pose a significant risk of hindering the conservation objectives.

Where additional assessment effort is required of developers, this will necessarily entail additional review effort by regulators and their advisors. Based on information contained in the draft Regulatory Impact Assessment for the Scottish Marine Bill, the cost to regulators of reviewing developer submissions was estimated to be approximately 10% of the cost to the developer of preparing those submissions[128]. Additional regulatory and advisory costs associated with reviewing additional assessments have therefore been calculated on this basis.

The main areas identified where additional costs may be incurred in reviewing licensing and consent applications include:

[126] Scottish Government (2015) Scottish Inshore Fisheries Strategy 2015 [online] available at https://www2.gov.scot/Topics/marine/Sea-Fisheries/InshoreFisheries/InshoreFisheriesStrategy, accessed 15/11/2018.

[127] Scottish Inshore Fisheries Integrated Data System (SIFIDS) Project (undated) SIFIDS Brochure, [online] available at https://www.masts.ac.uk/media/36193/sifids-brochure-email-web.pdf, accessed 15/11/2018.

[128] RPA & ABPmer (2009). Full Regulatory Impact Assessment: Scottish Marine Bill.

- Planning applications for new or extended finfish and shellfish aquaculture installations (local authorities, particularly Western Isles, Argyll & Bute and Highland Councils);
- CAR licences for use of chemical therapeutants in finfish aquaculture installations (SEPA);
- Planning applications for coast and flood protection works;
- Oil and gas licences and permits for new oil and gas exploration and development (BEIS); and
- Marine licences for new development activity (multiple sectors) (Marine Scotland).

The cost impacts identified above will fall on the lead regulators for the relevant licensing regimes but also on SNH, the statutory nature conservation body.

Appendix C Site Assessments

See separate document: Appendix C - Site Assessment Tables

Appendix D Management Scenarios

D.1 Four MPA proposals Scenarios for ABPmer Sustainability Appraisal

The table below provides a summary of Marine Scotland's suggested scenarios for use in ABPmer's Sustainability Appraisal of the four proposed MPAs. This is intended to be read alongside SNH's 'Advice to Support Management' for each of the four sites. The management scenarios are split by pressure or activity, and all four sites are discussed in the table. The site(s) where each pressure or activity is present is specified and where management advice only applies to a particular site this is noted in brackets. For each activity, there are three scenarios – these are 'low', 'medium' and 'high'. In some cases, the low and medium scenarios are combined. In each case, the scenarios are additive i.e. the high scenario also includes the management outlined under low and medium. Site name abbreviations have been used: Sea of the Hebrides (SOH); North-east Lewis (NEL); Southern Trench (STR); and Shiant East Bank (SEB). Please note, the management for Inner Hebrides Carbonate Production Area will be covered by Priority Marine Feature (PMF) management Sustainability Appraisal and existing planning and licensing processes are considered sufficient, so no management scenarios are suggested here.

In order to develop the management scenarios for each marine sector, the relevant pressures/activities for those sectors were selected from the table (e.g. boat use applies to finfish aquaculture, shellfish aquaculture, energy generation, military activities, oil and gas, ports and harbours, power interconnectors, shipping, recreational boating and tourism).

Pressure/Activity	Site(s) affected	Scenarios		
		Lower	**Intermediate**	**Upper**
Aquaculture	SOH NEL	Follow current best practice guidelines.	50% of Acoustic Deterrent Devices (ADDs) to be replaced with basking shark/cetacean appropriate devices at end of their life.	Replacement of all Acoustic Deterrent Devices (ADDs) with antipredator nets.
Boat use[129]	SOH NEL STR	Follow Scottish Marine Wildlife Watching Code (SMWWC) and produce vessel management plans as required by licensing.		Vessel speeds[130] restricted to <6 knots within the 'shark awareness zones' between June and October (SOH).
Cables/pipelines	SOH NEL STR SEB	Follow existing best practice and licensing process for installation of new cables/pipelines by minimising disturbance to sandeel habitat (SOH, NEL), burrowed mud (STR), circalittoral sand and mixed sediment communities, and northern sea fan and sponge communities (SEB).		New cable/pipeline routes should avoid northern sea fan and sponge communities (SEB).
Noisy activities[131]	SOH NEL STR	Follow existing best practice mitigation measures/guidance.		No noisy activities during minke whale and basking shark high season (April-October) (SOH). No noisy activities during Risso's dolphin high season (May-October) (NEL). No noisy activities during minke whale high season (June-October) (STR).

[129] MoD activities are reserved and therefore cannot be controlled or limited. MoD has its own best practice guidelines for meeting obligations.

[130] All vessels except lifeline ferry services.

[131] Noisy activities include all activities which produce underwater noise which may disturb the protected features (particularly basking sharks and cetaceans). This includes, but may not be limited to, construction activities (pile driving and blasting) and marine surveys (seismic, side-scan sonar, mutlibeam, sub-bottom profiling). MoD activities are reserved and therefore cannot be controlled or limited. MoD has its own best practice guidelines for meeting obligations.

Pressure/Activity	Site(s) affected	Scenarios		
		Lower	**Intermediate**	**Upper**
Coastal development (excluding noise)	STR NEL SOH	Follow existing best practice and licensing process.	Minimise footprints of development to limit disturbance to burrowed mud (STR) and sandeel habitats.	
Life line ferry services	All	No additional management.		
Fishing (bottom-contacting mobile gear)	SOH NEL STR SEB	Follow best practice to minimise risk of bycatch of basking sharks (SOH).	Exclusion of hydraulic gear from sandeel habitat (SOH, NEL, STR). Exclusion of mobile/active gear from northern sea fan and sponge communities (SEB). Exclude targeted fishing for sandeels (SOH, STR, NEL). Exclude mobile gear from 20% of burrowed mud (STR) and circalittoral sand (SEB).	Exclude mobile gear from 40% of burrowed mud (STR) and circalittoral sand (SEB).
Fishing (static gear)	SOH STR NEL	Reduce risk of entanglement of basking sharks (SOH), minke whales (SOH, STR) and Risso's dolphins (NEL) by following best practice.	Exclusion of drift nets and set nets between April and October in 'shark awareness zones' (SOH). Exclusion of drift nets and set nets in the southern half of site (NEL).	Exclusion of drift nets and set nets between April and October across site (SOH). Exclusion of drift nets and set nets between June and October (STR). Exclusion of drift nets and set nets between May and October (NEL).
Fishing (pelagic)	STR NEL SOH	Reduce risk of entanglement of minke whales (SOH, STR), basking sharks (SOH) and Risso's dolphins (NEL) by following best practice.		Limit herring and sprat fishing effort to current levels (SOH, STR).

Pressure/Activity	Site(s) affected	Scenarios		
		Lower	**Intermediate**	**Upper**
Marine disposal sites	STR NEL SOH	Current best practice followed.		Siting of new marine disposal sites to minimise impacts on burrowed mud (STR) and sandeel habitat.
Ports and harbours	STR NEL SOH	See 'Coastal Development' and 'Noisy Activities' for relevant scenarios.		
Renewable energy	STR NEL SOH	Current best practice used to minimise impacts on burrowed mud (STR) and sandeel habitat.		Exclude development which could create a barrier to species movement in shark awareness zones (SOH).
Scientific survey/research	SOH STR NEL SEB	Survey work adhering to Scottish Marine Wildlife Watching Code (SMWWC) and current species licensing requirements (SOH, NEL, STR) Best practice adopted to minimise effects on burrowed mud (STR), sandeel habitat (NEL), sensitive sea fan and sponge communities, and circalittoral sand (SEB).		
Wildlife tour operators	STR NEL SOH	Follow existing best practice including Scottish Marine Wildlife Watching Code (SMWWC) and Wildlife Safe (WiSe) scheme.		Vessel speeds restricted to <6 knots within the 'shark awareness zones' between June and October (SOH).

Appendix E Abbreviations

ADD	Acoustic Deterrent Device
BEIS	Department for Business, Energy and Industrial Strategy
BRIA	Business and Regulatory Impact Assessment
CAR	Controlled Activities Regulations
CFP	Common Fisheries Policy
EIA	Environmental Impact Assessment
ES	Ecosystem Services
GDP	Gross Domestic Product
GVA	Gross Value Added
HVDC	High Voltage Direct Current
iVMS	Inshore Vessel Monitoring System
MCO	Marine Conservation Order
MCZ	Marine Conservation Zone
MESAT	Marine Environment and Sustainability Assessment Tool
MoD	Ministry of Defence
MPA	Marine Protected Area
MPV	Marine Protection Vessels
NEA	National Ecosystem Assessment
PEXA	Practice and Exercise Areas
pMPA	Proposed Marine Protected Area
PV	Present Value
RYA	Royal Yachting Association
SA	Sustainability Appraisal
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SEIA	Social and Economic Impact Assessment
SEPA	Scottish Environmental Protection Agency
SNH	Scottish Natural Heritage
SPA	Special Protection Area
UNCLOS	UN Convention on the Law of the Sea
VMS	Vessel Monitoring System
WFD	Water Framework Directive

Appendix E: Abbreviations

Cardinal points/directions are used unless otherwise stated. SI units are used unless otherwise stated.

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