Appendix A Sector Context, Assumptions and Assessment Methods

This appendix provides an overview of existing and potential future activity for the various marine sectors in Scotland that have been scoped into the assessment and outlines the methods used to assess the impacts of potential pMPAs on each sector. The sectors are:

- Aquaculture – Finfish
- Aquaculture – Shellfish
- Carbon Capture and Storage
- Coast Protection and Flood Defence
- Commercial Fisheries
- Energy Generation
- Military Activities
- Oil and Gas
- Ports and Harbours
- Power Interconnectors
- Recreational Boating
- Shipping
- Telecom Cables
- Tourism
- Water Sports

A.1 Aquaculture - Finfish

A.1.1 Sector Definition

For the purposes of this assessment, finfish aquaculture relates to the production of marine finfish species within sea-based aquaculture installations. Marine finfish species cultivated in land-based production systems or freshwater finfish species cultivated in freshwater installations have been excluded.

A.1.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A1.

Table A1: Finfish aquaculture information sources

Scale	Information Available	Date	Source
Scotland / regional	Marine finfish aquaculture sites	2018	Marine Scotland maps NMPi
Scotland / regional	Marine finfish aquaculture sites and species farmed	2018	Scotland's aquaculture http://aquaculture.scotland.gov.uk/
Scotland / regional	Scottish fish farm production survey (tonnage)	2017	Marine Scotland (2018)
Scotland	Volume (tonnage) and economic value of production	2016	SPICe (2018)
Scotland	Economic value and trends	2014/15	Highlands and Islands Enterprise (HIE) and the Scottish Aquaculture Innovation Centre (SAIC) (2017)
Scotland	Aquaculture trends	-	Scotland Food and Drink (2016)

Location and intensity of activity

Marine finfish aquaculture sites in Scotland are currently situated in coastal areas within a few miles of the shore with no sites found further offshore. Most sites are usually located in sheltered, semi-enclosed sea lochs and voes (sea-inlets). Finfish production sites are predominately distributed on Scotland's west coast and islands, see Figure A1. The National Marine Plan states that "there is a continuing presumption against further marine finfish farm developments on the north and east coasts to safeguard migratory fish species"[1].

Finfish aquaculture in Scotland is dominated by the farming of Atlantic salmon, although the production of rainbow trout significantly contributes to the industry. Other species farmed include brown/sea trout, halibut, lumpsucker and several species of wrasse (the latter two species produced for use as cleaner fish for the biological control of parasites in the Atlantic salmon production industry).

Scotland is the world's third largest producer of farmed Atlantic salmon after Norway and Chile[2]. In 2017, there were 226 active sites farming salmon, producing a total of 189,707 tonnes of Atlantic salmon, virtually all of which was produced in sea cages (only 26 tonnes of salmon was produced in seawater tanks on land). In the same year, there were 44 active sites farming rainbow trout (although only 7 sites which were sea-based), producing a total of 7,637 tonnes, of which 3,482 tonnes (46%) were produced from sea cages[3].

There are 4 finfish aquaculture sites within the SOH pMPA, with a further 2 within a 1 km buffer. There are no sites within the other pMPAs, with a single finfish aquaculture site within the 1 km buffer around the NEL pMPA. There are, however, a considerable

[1] Scottish Government, 2015. Scotland's National Marine Plan, A Single Framework for Managing Our Seas

[2] SPICe, 2018. Salmon farming in Scotland. 13 February 2018, SB 18-12 rev

[3] Marine Scotland Science, 2018. Scottish fish farm production survey 2017. Available online at: https://www.gov.scot/publications/scottish-fish-farm-production-survey-2017/

number of sites within inlets and sea lochs landwards of the SOH and NEL pMPA boundaries.

It is assumed, as a worst-case scenario, that all farms within the MPAs or within the 1 km buffers will use Acoustic Deterrent Devices (ADDs) to reduce predation of fish stocks, particularly by seals. These are designed to deter predators through acoustic emissions and are used in different ways at different sites[4].

Economic value and employment

Aquaculture in Scotland helps encourage sustainable economic growth in many coastal and rural communities in the Highlands and Islands.

In 2016, total Atlantic salmon production (162,817 tonnes) was worth £765.2 million by farm gate value[5] (Marine Scotland, 2017; values for other farmed finfish species were not presented due to commercial confidentiality). In 2017, Scottish farmed salmon exports to non-EU and EU countries were valued at £318 million and £283 million respectively (an increase from approximately £250 million and £200 million respectively in 2016)[6].

In 2016, 1660 people were employed in aquaculture production. The number of staff employed in the production of Atlantic salmon was 1,486 (1,379 full time and 107 part-time)[7]

It has been estimated that direct, indirect and induced impacts of salmon farming created 10,340 jobs in Scotland in 2014-2015 (although it should be noted that this includes smolt production which is not undertaken in the marine environment[8][9] and GVA was estimated to be £540 million[10]. Indirect jobs related to salmon farming include supply chain businesses (suppliers of equipment, transport, feed and husbandry inputs), organisations involved in research and innovation, downstream fish processing jobs, retail and catering sales in Scotland (of fish farmed in Scotland).

Future trends

The Scottish aquaculture industry has ambition to grow aquaculture production to 350,000 tonnes for marine finfish (approximately double the average harvest for

[4] Northridge, S.P., Gordon, J.G., Booth, C., Calderan, S., Cargill, A., Coram, A., Gillespie, D., Lonergan, M. and Webb, A. 2010. Assessment of the impacts and utility of acoustic deterrent devices. Final Report to the Scottish Aquaculture Research Forum, Project Code SARF044. 34pp.

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

[6]

[7] These figures refer specifically to fish production and do not include the associated processing and marketing activities.

[8] Highland and Islands Enterprise (HIE) and Marine Scotland, 2017. The value of aquaculture to Scotland. June 2017.

[9] SPICe, 2018. Salmon farming in Scotland. 13 February 2018, SB 18-12 rev.

[10] Highland and Islands Enterprise (HIE) and Marine Scotland, 2017. The value of aquaculture to Scotland. June 2017.

2014/2015) by 2030[11][12]. To reach these targets Scottish industry is preparing for modest expansion of production at existing nearshore (within 2km of the shore) sites and considerable expansion at existing and future (i.e. new) 'exposed' sites. How expansion of the industry is actually achieved (i.e. in relation to expansion of onshore, nearshore and/or exposed and offshore aquaculture sites) and to what extent these ambitions are realised will depend on numerous factors including the level of social acceptance of aquaculture, environmental sustainability, markets and economics, availability of marine space at sites with suitable environmental conditions and technological developments, including in relation to offshore aquaculture in more exposed locations. The Rural Economy and Connectivity Committee report on the current state of the salmon farming industry in Scotland[13] acknowledged the economic and social value that the industry brings to Scotland and recommended action is needed to address regulatory deficiencies, fish health and environmental issues to be able to achieve these growth targets. Future potential scenarios for aquaculture in Scotland, or the UK (including Scotland), have been explored in a number of studies[14,15,16].

A.1.3 Assumptions on Future Activity

Innovation and development in the finfish aquaculture sector is likely to focus on addressing the challenges raised by the Rural Economy and Connectivity Committee and the sector is confident of continued growth in the future, however, the location, timing and intensity of such development remain uncertain. It is likely that there will be some development further offshore.

A.1.4 Potential Interactions with pMPA Features

The principal impacts to potential pMPA features (and sub-features) from finfish aquaculture relate to habitat damage as a result of organic enrichment/sediment deposition. The discharge of therapeutants poses a risk to water quality and sensitive fauna in the vicinity of releases. Microbial pathogens may be introduced to the environment, and further contamination of the water column may occur with the application of industrial pesticides to target species. (JNCC & NE, 2011). Finfish aquaculture infrastructure may cause habitat damage (anchors and mooring chains)

[11] Black, K. and Hughes, A. 2017. Future of the sea: Trends in aquaculture. Foresight – Future of the sea evidence review. Foresight Government Office for Science. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/635209/Future_of_the_sea_-_trends_in_aquaculture_FINAL_NEW.pdf

[12] Highland and Islands Enterprise (HIE) and Marine Scotland, 2017. The value of aquaculture to Scotland. June 2017.

[13] REC, 2018. Salmon farming in Scotland, [online] available at http://www.parliament.scot/abouttheparliament/91279.aspx

[14] Black, K. and Hughes, A. 2017. Future of the sea: Trends in aquaculture. Foresight – Future of the sea evidence review. Foresight Government Office for Science. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/635209/Future_of_the_sea_-_trends_in_aquaculture_FINAL_NEW.pdf

[15] Highland and Islands Enterprise (HIE) and Marine Scotland, 2017. The value of aquaculture to Scotland. June 2017.

[16] Celtic Seas Partnership, 2016. Future Trends in the Celtic Seas, Scenarios Report, ABPmer Report No. R.2584d. A report produced by ABPmer & ICF International for Celtic Seas Partnership, August 2016. Available online: http://futuretrends.celticseaspartnership.eu/downloads/R2584d%20Future%20Trends_Final%20Scenarios%20Report_5Aug2016_High_res.pdf

and structures present low-scale barriers for mobile species, as well as a risk of death or injury by collision or entanglement. Nutrient enrichment may occur in the vicinity of finfish farms but there is no evidence that this has led to eutrophication. Installations may also provide suitable surfaces for colonisation by invasive non-native species (INNS) potentially supporting the wider spread of INNS. There is potential for human activity associated with the operation of fish farm installations, including boat movements, to cause visual and noise disturbance to fish and marine mammals.

The emission of noise from the use of ADDs associated with finfish aquaculture has the potential to interact with mobile features within the pMPA sites, particularly associated with cetaceans and fish species.

Interactions between finfish aquaculture sites and the environment are currently managed through the planning process, including production of EIAs and applications for Controlled Activities Regulations (CAR) licences.

A.1.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Follow current best practice guidelines;
- Additional assessment of new development proposals within or adjacent to MPAs to support planning applications;
- Additional assessment costs for marine licence renewals within or adjacent to pMPAs;
- The replacement of 50% of ADDs with basking shark / cetacean appropriate devices at end of life; or the replacement of all ADDs with anti-predator nets (dependent on scenario, see Appendix D);
- Development of and compliance with vessel management plans as required by licencing (New applications only); and
- Restriction of vessel speeds to <6 knots within the Shark Awareness Zones between June and October (SOH only).

Where the pMPAs overlap with existing designated sites, it is possible that existing or planned management measures will contribute to achievement of the conservation objectives for the pMPAs. Assumptions on the management scenarios assessed are presented in Appendix D. The site assessments (Appendix C) provide further information on how these assumptions have been applied to individual sites. No scenarios are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

A.1.6 Assessment Methods

Follow current best practice guidelines

Aquaculture sites are already following the best practice guidelines, therefore there is no cost associated with this management measure.

Additional assessment to support planning applications

SSPO estimates that there will be 10 planning applications (new installations or extensions) that may be submitted within the SOH and NEL MPAs in the next ten years, and a further 10 in the subsequent 10 years within the assessment period. For the purposes of this assessment, it has been assumed that 90% of the planning applications for pMPAs relate to the SOH pMPA and 10% to NEL pMPA. For SOH pMPA, it has been further assumed that a proportion of these will also relate to the Inner Hebrides and the Minches cSAC for harbour porpoise, which overlaps part of the SOH pMPA. Therefore costs for two new sites are included in the SOH pMPA assessment.

It has been assumed that these applications will require additional assessment of the potential impacts to features (and sub-features) proposed for protection, as required under the Marine (Scotland) Act 2010. This information would either be reported within the Environmental Impact Assessment (EIA) if required, or as a separate MPA assessment. It is assumed that the additional assessments will fall in 2024 and 2034 and the cost of each assessment will be £5,600[17] at 2019 prices.

It has been assumed that there are no cost impacts associated with the designation or management of either the STR or SEB pMPAs, as there is currently no activity in these areas and it is considered unlikely that there will be any established during the assessment period.

Replacement of 50% of end of life ADDs with cetacean / basking shark appropriate devices

It has been assumed that aquaculture sites within 1 km of the MPAs will replace ADDs every six years. Of the six finfish aquaculture sites within a 1km buffer of the SOH pMPA, five are also within a 1km buffer of the Inner Hebrides and the Minches cSAC which would require similar measures. Therefore only one site is included in the costings for SOH pMPA. For the number of new sites/applications, the same assumptions are used as for ‘additional assessment to support planning applications’.

The cost to procure a cetacean-appropriate ADDs compared to the current industry standard is assumed to be 20% greater and therefore it has been assumed that the

[17] This figure is a notional amount to reflect the likelihood that some minor additional assessment and reporting will be required. It is based on industry knowledge and experience of writing such assessments, and it is considered that the majority of information required would already be prepared to inform the EIA / Environmental Report, therefore this additional cost is relatively minor. This figure is applied across all relevant sectors (with the exception of Ports and Harbours for which a separate industry-specific value is used). It represents an average value for the purposes of assessment and in practice the actual value incurred may be higher or lower.

additional cost to replace 50% of ADDs with cetacean and basking shark appropriate devices at an aquaculture site is £11,500 at 2019 prices[18].

It is assumed that replacing 50% of the ADDs is a phased approach that leads to 100% of ADDs being cetacean appropriate when replaced in the second cycle. Therefore after year 6 it is assumed that the cost per site is £23,000.

It is additionally assumed that all new sites will be required to use 100% cetacean-appropriate ADDs at a cost of an additional £23,000 per site with the cost applicable at first establishment of the site and every six years thereafter.

Replacement of all ADDs with antipredator nets

The cost of antipredator nets is assumed to be £48,000 per site at 2019 prices[19]. It has been assumed that the installation of the nets would be phased in with the replacement of ADDs at the sites. For the number of new sites/applications, the same assumptions are used as for 'additional assessment to support planning applications'. Therefore, it is assumed that the costs are phased in over the first six years (2019-2024).

It is assumed that new sites would be required to use antipredator nets in place of ADDs at a cost of £48,000 per site. For the number of new sites/applications, the same assumptions are used as for 'additional assessment to support planning applications'. It is assumed that anti-predator nets require replacement every 10 years.

Development of and compliance with vessel management plan

It is assumed that all new finfish aquaculture installations will be required to produce a vessel management plan, in line with current licensing requirements, which takes into account the protected features at the sites and mitigates appropriately. It has been assumed that the consideration of pMPA features in the vessel management plans will, at most, increase the vessel management plan development cost by £1,000[20].

Restriction of vessel speeds to <6 knots in Shark Awareness Zone

There are no current aquaculture sites which are within a Shark Awareness Zone or where routes to the site from home ports are likely to transit the Shark Awareness Zones. There is therefore assumed to be no cost to finfish aquaculture associated with this management measure.

There is potential for new fish farms to be established within the Shark Awareness Zones, however there is assumed to be no cost associated with these speed restrictions, as any potential time delays are considered to be negligible.

[18] This figure has been uprated from the 2015 value in the following source: ABPmer, 2015. Developing the evidence Base for Impact Assessments for Recommended dSACs and dSPAs, for Joint Nature Conservation Committee. ABP Marine Environmental Research Ltd, Report No. R.2462.

[19] This figure has been uprated from the 2015 value in the following source: ABPmer, 2015. Developing the evidence Base for Impact Assessments for Recommended dSACs and dSPAs, for Joint Nature Conservation Committee. ABP Marine Environmental Research Ltd, Report No. R.2462.

[20] This figure is for minor additional assessment to incorporate the MPA features into a VMP, and is based on industry knowledge and experience.

Cost of uncertainty and delays

The designation of pMPAs has the potential to increase the time taken to determine planning or marine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

A.1.7 Limitations

- The number and location of future planning applications is uncertain;
- The size of current sites (and therefore the number of ADDs devices or length of antipredator nets required) is uncertain;
- There is uncertainty as regards the suitability of sites for the installation of antipredator nets; and
- The level and location of future planning applications and applications for marine licences is uncertain.

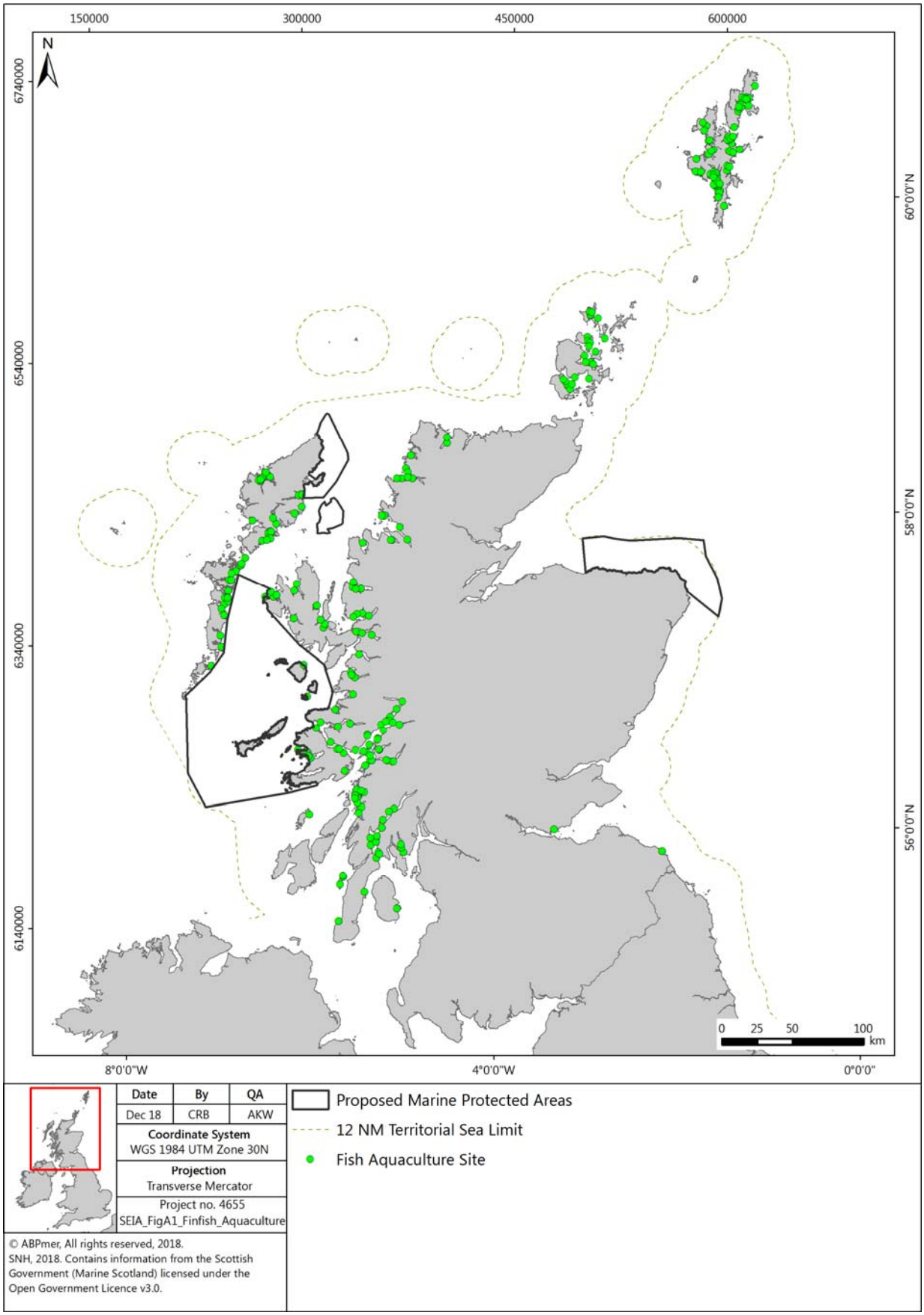


Figure A1 Finfish aquaculture sites in Scotland

A.2 Aquaculture – Shellfish and seaweed

A.2.1 Sector Definition

For the purposes of this assessment, shellfish aquaculture relates to the production of marine shellfish within aquaculture installations excluding cultivated shellfish beds which are covered under commercial fishing. It includes long-line cultivation of mussels and oyster cultivation on-shore.

Seaweed aquaculture relates to the production of macroalgae within sea-based aquaculture installations. Such installations are currently limited to experimental/research sites in Scotland.

A.2.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A1.

Table A2 Shellfish aquaculture information sources

Scale	Information Available	Date	Source
Scotland / regional	Shellfish aquaculture sites	2018	Marine Scotland maps NMPi
Scotland / regional	Shellfish aquaculture sites and species farmed	2018	Scotland's aquaculture http://aquaculture.scotland.gov.uk/
Scotland	Scottish shellfish production survey – volume and economic value	2017	Marine Scotland Science (2018)
Scotland	Future trends	-	Black and Hughes (2017)

Location and intensity of activity

Marine shellfish aquaculture sites in Scotland are currently situated in coastal areas within a few miles of the shore with no sites found further offshore. Most sites are also situated in sheltered, semi-enclosed sea lochs and voes (sea-inlets) and are distributed all along the West coast including the Hebrides and around Shetland with far fewer sites located on the East coast, see Figure A2.

In 2017, there were 132 authorised shellfish aquaculture businesses in Scotland, operating 332 active sites, of which 53% were producing shellfish for the market (i.e. for consumption)[21]. There is very little activity within the pMPAs, with 3 sites within the SOH pMPA and 3 further sites within an additional 1 km buffer. There are no other sites within or in a 1 km buffer around the other pMPAs. Similarly to the finfish aquaculture sector, however, there are a considerable additional number of shellfish sites landwards of both the NEL and SOH pMPA boundaries outside of the 1 km buffer.

[21] 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/.

Shellfish production was dominated by mussels and Pacific oyster, although small quantities of scallop, queen scallop and native oyster were also produced. Additional species farmed in small quantities in 2017 were whiteleg shrimp and periwinkle.

In 2017, shellfish aquaculture in Scotland produced 8,232 tonnes of mussel and 403 tonnes of Pacific oysters for consumption. Production of native oysters amounted to 16 tonnes, while scallop production amounted to 17 tonnes in total (11 tonnes queen scallop; 6 tonnes scallops). The vast majority of the mussel production in Scotland is located in Shetland, which accounted for 6,647 tonnes (81%) of the total mussel production in Scotland in 2017. The production of Pacific oysters was mostly limited to the Strathclyde and Highland regions, which collectively accounted for 3,086 tonnes and 1,799 tonnes respectively (97% in total) of Scotland's total Pacific oyster production in 2017.

Although there is interest and research into the viability of cultivating seaweed (e.g. for bioenergy production and speciality food ingredients) in Scotland, at present, there is no commercial-scale cultivation of seaweed and this sector is limited to research/trial sites and the economic viability of the sector remains uncertain. As such, seaweed is not considered further within the socio-economic impact assessment.

Economic value and employment

In 2017 the total value of shellfish aquaculture in Scotland at first sale (for table trade) was estimated at £12.4 million. Mussel cultivation contributed the most to the value of the sector during 2017; valued at £10.1 million, while Pacific oysters contributed £2.01 million; native oysters £0.12 million; scallops £0.09 million and Queen scallops £0.003 million[22].

The Scottish shellfish cultivation industry employed a total of 146 full-time and 182 part-time and casual workers during 2017. The highest number of full-time staff were employed in Shetland (61), followed by Strathclyde (41), although Strathclyde had the highest number of staff in total (105 full-time and part-time/casual, compared to 100 in Shetland)[23].

Future trends

The aquaculture industry has ambition to grow production to 21,000 tonnes for mussels (a 133% increase on the average harvest for 2014/2015 harvest) by 2030[24][25]. How expansion of the industry is achieved (e.g. via expansion of on-shore, near-shore and/or offshore aquaculture) and to what extent these ambitions are realised will depend on numerous factors including the level of social acceptance of shellfish aquaculture, environmental sustainability, markets and economics, availability of marine space at sites with suitable environmental conditions and technological developments,

[22] 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/.

[23] Ibid

[24] Black, K. and Hughes, A. 2017. Future of the sea: Trends in aquaculture. Foresight – Future of the sea evidence review. Foresight Government Office for Science. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/635209/Future_of_the_sea_-_trends_in_aquaculture_FINAL_NEW.pdf

[25] HIE and Marine Scotland (2017). The value of aquaculture to Scotland. June 2017.

including in relation to offshore aquaculture in more exposed locations. Future potential scenarios for aquaculture in Scotland, or the UK (including Scotland), have been explored in a number of studies[26,27,28].

Assumptions on Future Activity

There is likely to be continued growth in the shellfish aquaculture sector in the future, however, the location, timing and intensity of such development remain uncertain. It is likely that there will be some development further offshore.

A.2.3 Potential Interactions with pMPA Features

Habitat loss may occur beneath shellfish lays and the deposition of 'mussel mud' and increased sedimentation may lead to smothering, although this may be temporary until harvesting occurs. Organic enrichment can lead to increased settlement and growth of green macroalgae and changes in community composition. Shellfish lays are known to cause a decrease in species richness and the number of individuals in nearby benthic communities, with a decrease in macrofauna and an increase in meiofauna. Anchors used to fix ropes for rope-grown mussels may also cause localised abrasion of the benthic environment (JNCC & NE, 2011). Installations may also provide suitable surfaces for colonization by invasive non-native species potentially supporting the wider spread of INNS. There is potential for human activity associated with the operation of shellfish installations to cause visual and noise disturbance to fish and marine mammals.

Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Follow current best practice guidelines;
- Additional assessment of new development proposals within or adjacent to MPAs to support planning applications;
- Development of and compliance with vessel management plan.

Where the pMPAs overlap with existing designated sites, it is possible that existing or planned management measures will contribute to achievement of the conservation objectives for the pMPAs. Assumptions on the management scenarios assessed are

[26] Black, K. and Hughes, A. 2017. Future of the sea: Trends in aquaculture. Foresight – Future of the sea evidence review. Foresight Government Office for Science. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/635209/Future_of_the_sea_-_trends_in_aquaculture_FINAL_NEW.pdf

[27] Highland and Islands Enterprise (HIE) and Marine Scotland, 2017. The value of aquaculture to Scotland. June 2017.

[28] Celtic Seas Partnership, 2016. Future Trends in the Celtic Seas, Scenarios Report, ABPmer Report No. R.2584d. A report produced by ABPmer & ICF International for Celtic Seas Partnership, August 2016. Available online: http://futuretrends.celticseaspartnership.eu/downloads/R2584d%20Future%20Trends_Final%20Scenarios%20Report_5Aug2016_High_res.pdf

presented in Appendix D. The site assessments (Appendix C) provide further information on how these assumptions have been applied to individual sites.

No scenarios are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

A.2.4 Assessment Methods

Follow current best practice guidelines

Aquaculture sites are already following the best practice guidelines, therefore there is no cost associated with this management measure.

Additional assessment to support planning applications

The 2030 objective of increasing Scottish shellfish production to 21,000 tonnes p.a. has been used as an indication of the desire to develop the shellfish aquaculture of the industry. To realise this development there will need to be a significant expansion of the industry. On this basis it has been assumed that there will be 8 planning applications (new installations or extensions) within the pMPAs in the next ten years (this will be an approximate doubling of the current number of shellfish aquaculture sites within the MPAs) that may be submitted in the next ten years within or adjacent (within 1km) to the pMPA proposals. It is then assumed that the industry will continue to grow at this rate, with an additional 8 applications in the subsequent ten years.

The total number of planning applications in each ten year period (2019 to 2028 and 2029 to 2038) has been assigned as 7 in SOH pMPA and 1 in NEL pMPA, as these are the only locations with any current shellfish aquaculture in the vicinity of the pMPAs. The proportions are based on the relative number of existing installations within each pMPA.

These applications will require additional assessment of the potential impacts to features (and sub-features) proposed for protection, as required under the Marine (Scotland) Act 2010. This information would either be reported within the EIA if required, or as a separate MPA assessment. It is assumed that the additional assessments will fall in 2024 and 2034 and the costs of each assessment will be £5,600[29] at 2019 prices.

It has been assumed that there are no cost impacts associated with the designation or management of either the STR or SEB pMPAs, as there is currently no activity in these areas and it is considered unlikely that there will be any established during the assessment period.

[29] This figure is a notional amount to reflect the likelihood that some minor additional assessment and reporting will be required. It is based on industry knowledge and experience of writing such assessments, and it is considered that the majority of information required would already be prepared to inform the EIA / Environmental Report, therefore this additional cost is relatively minor. This figure is applied across all relevant sectors (with the exception of Ports and Harbours for which a separate industry-specific value is used).

Development of and compliance with vessel management plan

It is assumed that new shellfish aquaculture installations will be required to produce a vessel management plan, in line with current licencing requirements, which considers the protected features at the sites and mitigates appropriately. It has been assumed that the consideration of pMPA features in the vessel management plans will, at most, increase the vessel management plan development cost to the operator by £1,000.

Restriction of vessel speeds to <6 knots in Shark Awareness Zone

There is one current shellfish aquaculture site (Sound of Canna) which is within a Shark Awareness Zone. The site is approximately 3 km from the edge of the Shark Awareness Zone and therefore a reduction in speed from 10 knots to 6 knots would have a negligible impact on the sector (approximately an additional 6 minutes per transit). There are no additional aquaculture sites where routes to the site from home ports are likely to transit the Shark Awareness Zones, and it is assumed that any time delays to new sites which have the potential to be located within the Shark Awareness Zones will be negligible. There is assumed to be no cost associated with this impact.

Cost of uncertainty and delays

The designation of pMPAs has the potential to increase the time taken to determine planning applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

Limitations

- The level and location of future planning applications is uncertain.

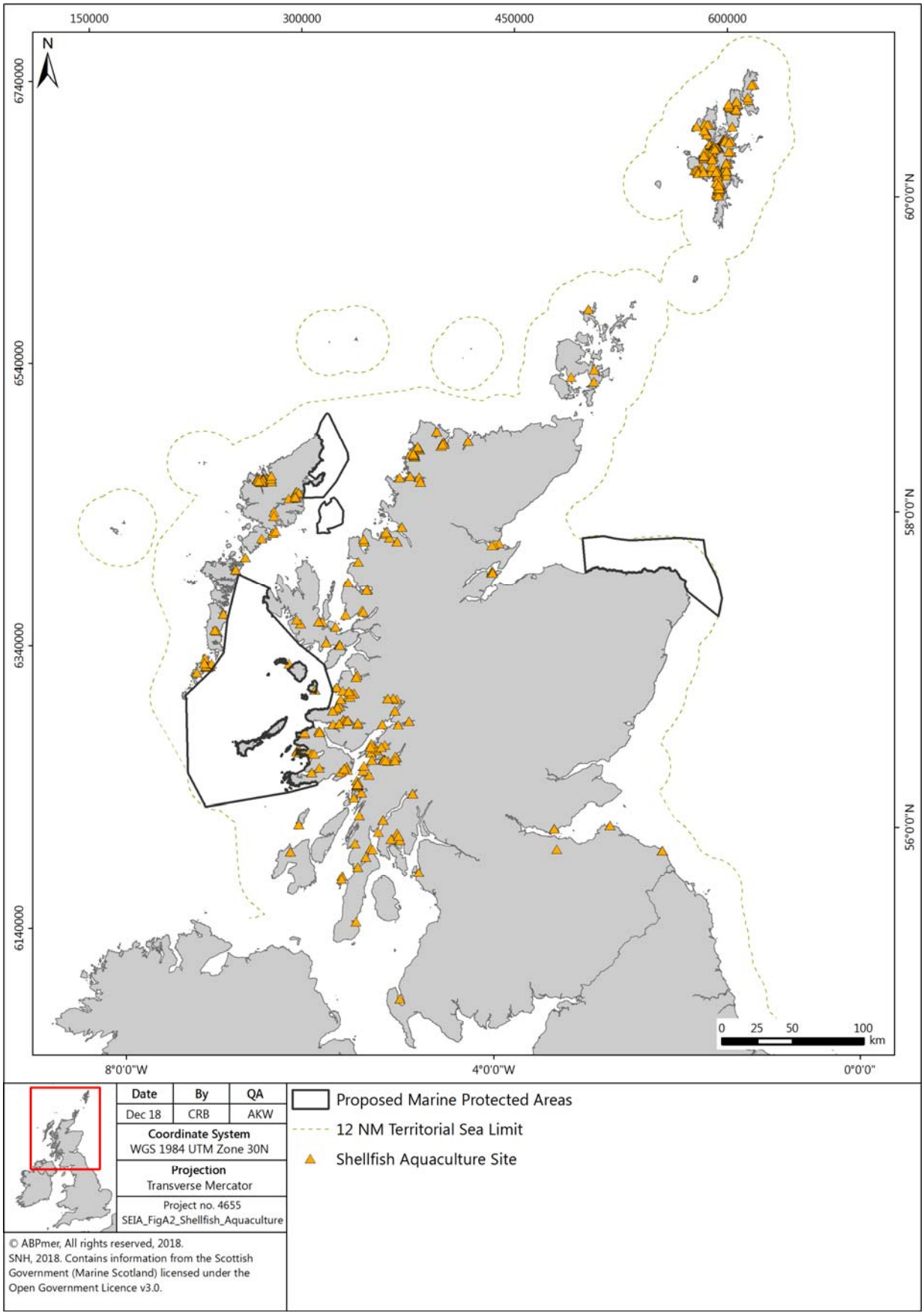


Figure A2 Shellfish aquaculture sites around Scotland

A.3 Carbon Capture and Storage

A.3.1 Sector Definition

Carbon Capture and Storage (CCS) is a carbon abatement technology that will enable fossil fuels to be used with substantially reduced carbon dioxide (CO_2) emissions. CCS combines three distinct processes: capturing the CO_2 from power stations and other industrial sources, transporting it (usually via pipelines) to storage points, then injection of the CO_2 into deep geological formations (e.g. deep saline formations or depleted oil and gas fields) for long term storage.

A.3.2 Overview of Existing Activity

Information sources used in the assessment are listed in Table A3.

Table A3 Carbon capture and storage information sources

Scale	Information Available	Date	Source
Scotland	Potential CO_2 storage sites, transport options between sources and storage sites (ship and pipeline)	2009	Scottish Centre for Carbon Storage (SCCS) (2009)
Scotland	Refined estimate of CO_2 storage capacity in North East Region, estimates of timelines to CCS deployment and employment estimates	2011	Scottish Centre for Carbon Storage (SCCS) (2011)
Scotland	Potential transport options and possible European CCS Network	2011	Scottish Government and Scottish Enterprise (2011)
Scotland	Potential CO_2 storage sites (based on above data sources)	2011	Baxter et al. (2011)
Scotland	Site selection reports, business cases and development plans for ACT Acorn CCS project	2018	Actacorn.eu
UK	Aquifers (polygon)		BGS
UK	Large dome structures in the Bunter Sandstone Formation (polygon)		BGS / DECC
UK	Proximity of the UK's largest industrial emitters to least cost storage capacity	2012	DECC, (2012)
UK	Technical, economic, financial and social uncertainties facing CCS, potential role in UK power sector to 2030	2012	UK Energy Research Centre (UKERC), (2012)
UK / Global	Global CCS Map	2018 / Current	Scottish Centre for Carbon Storage (SCCS) (2018) www.sccs.org.uk/map

Scale	Information Available	Date	Source
UK	The economic benefits of carbon capture and storage in the UK	2013	CCSA and TUC (2013)
UK	Carbon capture and Storage. Ninth Report of Session 2013–14	2014	House of Commons (2014)
UK	A UK Vision for Carbon Capture and Storage	2013	Orion Innovations (2013)

Location and intensity of activity

Although CCS is an active field of research and development and a growing industry, with 15 large-scale CCS projects in operation globally, there are currently no full-scale CCS demonstration projects in operation at coal- or gas-fired power plants in the UK.

A study into the opportunities for CO_2 storage around Scotland[30] showed Scotland has an extremely large CO_2 storage resource. Out of the 204 hydrocarbon fields and 80 saline aquifers identified within the study area, 29 hydrocarbon fields and 10 saline aquifers were identified as having apparent potential for CO_2 storage, all of which lie in offshore waters within the Central and Northern North Sea. Further assessment of these sites showed that four gas condensate fields (Brae North, Brae East, Britannia and Bruce Fields), one gas field (Frigg Field) and one oil field (Brent Field) presented the most obvious opportunities as stores, with CO_2 storage capacities of between 300-1,000 million tonnes (Mt). The report noted that the three high pressure high temperature (HPHT) gas condensate fields (Franklin, Elgin and Shearwater fields) are likely to be too expensive to develop as stores in the short term. Fourteen oil fields, including the Brent Oil Field, were identified as having potential for CO_2 storage in conjunction with enhanced oil recovery. The remaining seven oil fields offer large storage capacities but reservoir pressure may present obstacles to their use for CO_2 storage. Out of the 80 saline aquifers identified within the study, ten were identified as meeting both geotechnical and storage capacity requirements (all of which lie within offshore waters in the Central and Northern North Sea) with a total potential CO_2 capacity in the range 4,600-46,000 Mt. The study concluded that these resources could easily accommodate the industrial CO_2 emissions from Scotland for the next 200 years, with likely sufficient storage to allow import of CO_2 from north-east England, equating to over 25% of future UK large industry and power CO_2 output. Pipelines were assessed as the best option for the secure and continuous transport of CO_2 from different sources to collection hubs onshore and then to offshore storage hubs for local distribution to storage sites. In 2011, a study showed that the storage capacity of one of the saline aquifers identified in the 2009 study (the Captain Sandstone beneath the Moray Firth, Figure A3) was estimated to be over 360 Mt of CO_2, with the potential for an additional 1200 Mt storage capacity with significant investment[31]. This equated to about 15-100 years of CO_2 output from Scotland's existing industrial sources.

There is a small-scale project (ACT Acorn) in early stage planning, to develop a CCS facility exporting from the St Fergus gas station partially utilising existing pipeline

[30] Scottish Centre for Carbon Storage (SCCS), 2009. Opportunities for CO_2 storage around Scotland: An integrated strategic research study. Report for the Scottish Government. April, 2009.

[31] Scottish Centre for Carbon Storage (SCCS), 2011. Progressing Scotland's CO2 storage opportunities. Report for the Scottish Government. March, 2011.

infrastructure (Goldeneye, Atlantic and Miller Gas pipelines) to store captured carbon in the Captain Sandstone aquifer. It should be noted that projects that were previously identified, including the Peterhead CCS project, have not been taken forwards due to changes in government policy and the removal of funding streams[32].

Economic value and employment

This sector is currently in its infancy and there is currently no CO_2 storage in place. Therefore information is limited on the current economic value or employment. Across the UK investment in CCS is estimated at £5m per annum, with an employment base of less than 500 employees[33]. Data specific to Scotland is not available for disclosure reasons.

Future trends

The Scottish Government and Scottish Enterprise[34] stated that the emerging CCS-based industry in Scotland could support up to an estimated 10,000 new jobs in the next 15-20 years. A more recent study stated that an appropriately skilled and trained workforce, in addition to that already engaged in the engineering and offshore industries, will be an essential component of the new CCS industry in the UK and estimated that CCS could create 13,000 jobs in Scotland (and 14,000 elsewhere in the UK) by 2020 and increase in the following years[35]. This study also estimated that the UK plc share of the worldwide CCS business is potentially worth over £10 billion per year from around 2025, with the added value in the UK worth between £5-9.5 billion per year[36].

At the individual project scale (based on evidence from an operational installation in Canada), approximately 1000-2,500 jobs could be created during plant construction (typically four to six years) per power plant CCS installation (related to new-build CCS power plant only, not retrofit CCS power plant). Once construction is complete, typical plant estimates predict 200–300 jobs in operation and maintenance and the associated supply chain, of which 40–100 jobs would be at the plant itself[37]. In 2013 it was estimated that by 2030, projections of CCS-installed capacity in the UK range from 10 to 20 GW, translating to between 15 and 25 CCS installations. Using the previous figures of job generation per installation, it was estimated that the total annual number of jobs that could be created in the CCS industry in the UK by 2030 ranged from

[32] Shell U.K Limited (Shell), 2015b. Peterhead CCS Project Announcement [online] available at https://www.shell.co.uk/about-us/latest-news-and-features/2015-news-and-features/peterhead-ccs-project-announcement.html accessed 17/09/2018.

[33] ONS (2018) UK Environmental Accounts: Low Carbon and Renewable Energy Economy Survey: 2016 final estimates (and associated data). Available from: https://www.ons.gov.uk/economy/environmentalaccounts/bulletins/finalestimates/2016

[34] Scottish Government and Scottish Enterprise, 2011. Carbon Capture and Storage – A Roadmap for Scotland. Progress Report – May 2011.

[35] Scottish Centre for Carbon Storage (SCCS), 2011. Progressing Scotland's CO2 storage opportunities. Report for the Scottish Government. March, 2011.

[36] ibid

[37] CCSA and TUC, 2013. The economic benefits of carbon capture and storage in the UK.

15,000-30,000[38]. However, given the slow pace of progress with the CCS programme since 2013, overall development of the industry will be delayed.

CCS on fossil fuel power generation may have an important role in helping to meet Scotland's climate change targets of an 80% reduction in greenhouse gas (GHG) emissions by 2050. The Scottish Government and Scottish Enterprise[39] stated that in order to make significant progress towards Scotland's climate change targets the electricity generation sector needs to be decarbonised by 2030. To meet this target Scotland previously set the goal of having one or more demonstrator projects operational by 2015 to ensure that CCS is available on a commercial scale from 2020 and can be widespread in the sector by 2030 (including the retrofitting of CCS to existing plants). The Committee on Climate Change (CCC) report to government identifies the reduction in expected uptake of CCS from the initial targets discussed above with limited expected uptake by 2030[40]. In order to help the progression of the industry the Scottish Government is supporting approximately £100k of the €1.9m EU Acorn CCS Project[41]. Challenges to this emerging sector include demonstrating that CCS is economically and technically feasible, that CCS is permanent (proposed sites must be investigated and evaluated to demonstrate they are suitable for secure storage of CO_2 for thousands of years) and whether the technology can be developed within a timescale that enables utilisation of the existing oil and gas infrastructure (platforms and pipelines) before decommissioning occurs[42]. Potential storage sites may increase as further hydrocarbon fields or saline aquifers suitable for CO_2 storage may yet be discovered[43].

A.3.3 Assumptions on Future Activity

Scottish Enterprise and Scottish Development International (undated) set out a series of possible scenarios for the future development of CCS in Scotland up to 2040. The scenarios assumed that by 2020, the only CCS development in Scottish waters would be between Peterhead and the Goldeneye platform, using existing infrastructure. This report was, however, produced prior to the loss of government funding for the project, which has, at the current time, halted progress in this area.

For the purpose of this assessment, it is assumed that the only development that occurs is the ACT Acorn project, which currently undergoing a feasibility study and which aims to deliver a low-cost CCS system re-using oil and gas pipeline infrastructure in north east Scotland by 2023.

[38] ibid

[39] Scottish Government and Scottish Enterprise, 2011. Carbon Capture and Storage – A Roadmap for Scotland. Progress Report – May 2011.

[40] Committee on Climate Change, 2018. Reducing emissions in Scotland, 2018 progress report to parliament, September 2018. https://www.theccc.org.uk/wp-content/uploads/2018/09/Reducing-emissions-in-Scotland-2018-Progress-Report-to-Parliament.pdf

[41] ibid

[42] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[43] Scottish Centre for Carbon Storage (SCCS), 2009. Opportunities for CO2 storage around Scotland: An integrated strategic research study. Report for the Scottish Government. April, 2009.

A.3.4 Potential Interactions with pMPA Features

Impacts on pMPA features associated with CCS are likely to be similar to those associated with oil and gas exploration and production (see Appendix A.8). Although additional impacts are not yet known due to the lack of CCS activity in UK waters, they include potential ocean acidification associated with the unplanned release of CO_2[44]. The only site where interaction is expected to occur is the STR pMPA, through which the proposed pipeline infrastructure for the ACT project would run.

A.3.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Additional assessment of the impact of the development proposal on pMPA features to support marine licence determination (STR only);
- Following existing best practice and licensing process for installation of new cables / pipelines by minimising disturbance to burrowed mud (STR only); and
- No noisy activities during minke whale and basking shark high season (April-October) (SOH, STR);

Additional costs will apply only to the ACT Acorn project in STR pMPA, and therefore there are assumed to be no costs to the CCS industry associated with the designation or management of SOH, SEB or NEL pMPAs.

A.3.6 Assessment Methods

<u>Additional assessment to support marine licence application</u>

It is assumed that additional assessment will be required to determine and manage the impact of CCS development on pMPA features to support marine licence applications, as required under the Marine (Scotland) Act 2010. This information would either be reported within the EIA if required, or as a separate MPA assessment. It is assumed that the cost of this additional assessment will be £5,600 (at 2019 prices), incurred in 2020.

<u>Following existing best practice and licensing process for installation of new cables / pipelines by minimising disturbance to burrowed mud (STR only).</u>

The CCS industry will already follow best practice as part of the licensing process, and therefore there is no additional cost associated with this management measure.

[44] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR)

The current proposals would use existing infrastructure, and will therefore not undertake major construction within STR. However, it is assumed that survey activity of the existing infrastructure will be required, potentially including multibeam, sidescan sonar and sub-bottom profilers. This survey, specifically the approximately 12 nm of pipeline within STR, is assumed to take 3 days of survey time to cover three transect lines and will be undertaken annually.

This survey activity within the STR pMPA will be required to be undertaken November – March, and there is increased likelihood of weather downtime during this period. To assess any impact of increased downtime it has been assumed that this will double the time taken to undertake the survey. As such 3 days of survey time, which would take 4 days in summer (with 1 day of weather downtime) will take 8 days in winter (with 5 days of weather downtime). The additional downtime for a 3 day survey is therefore 4 additional days[45].

It has been assumed that downtime costs are £10,000 per day at 2019 prices[46]. It has been assumed that the restriction on survey activity will not require an additional mobilisation, which would potentially have an additional impact due to mobilisation and demobilisation costs.

A.3.7 Limitations

- The number and location of CCS pipelines and installations that may be constructed during the assessment period is unknown.
- All costs related to weather related downtime, are estimates only, as in reality conditions may be better or worse and costs will vary.

[45] This figure is based on survey industry experience.

[46] This figure is based on knowledge of the survey industry and is the approximate weather downtime cost for a medium sized survey vessel including staffing costs. This has the potential to be lower or higher, depending on the specific vessel.

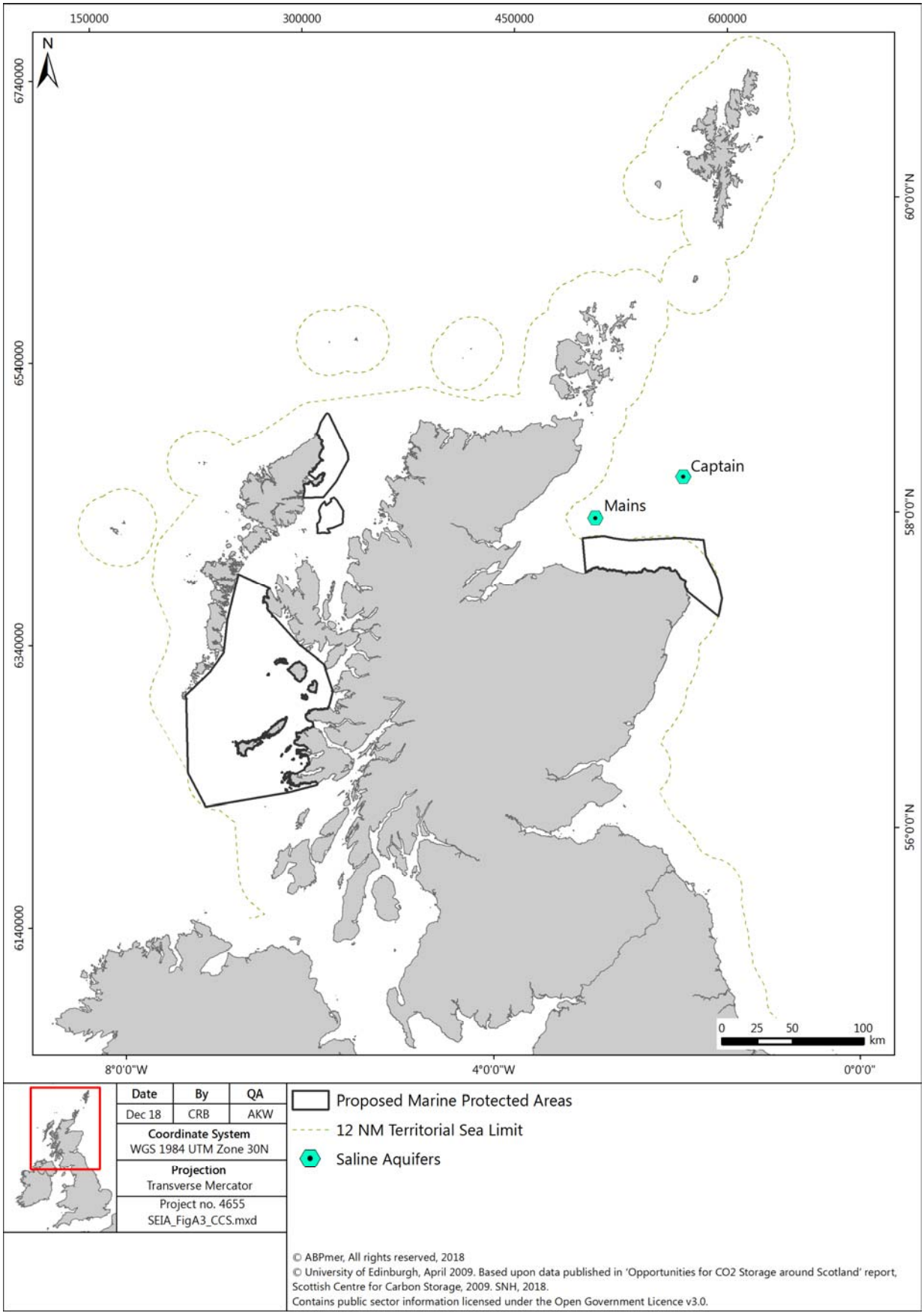


Figure A3 Saline aquifers identified as having the greatest potential for development

A.4 Coast Protection and Flood Defence

A.4.1 Sector Definition

This sector includes coastal defence measures used to prevent or reduce flood risk and coastal erosion[47]. Examples of coastal and flood defences include groynes, sea walls and embankments (termed 'hard engineering') and beach replenishment, managed retreat and coastal realignment (termed 'soft engineering').

A.4.2 Overview of Existing Activity

Information sources used in the assessment are listed in Table A4.

Table A4 Coast protection and flood defence information sources

Scale	Information Available	Date	Source
Scotland	Coastal protection, flood defence and managed realignment schemes	2011	Scotland's Marine Atlas and National Marine Plan interactive (NMPi) mapping layer.
Scotland	National Flood Risk Assessment	2011	Scottish Environment Protection Agency's (SEPA) National Flood Risk Assessment
Europe	EUROSION: Erosion trends and coastal defence works	2004	http://www.eurosion.org/database/index.html
Scotland	The Local Flood Risk Management Strategy (FRMS) for 14 districts in Scotland.	2016	SEPA's Local Flood Risk Management Strategy

Location and intensity of activity

There is currently no nationally-collated database of flood defence assets,[48] but SNH estimated that 307 km of mainland Scotland's coast comprises coastal defences[49]. The distribution of coastal protection schemes and hard and soft engineered flood prevention schemes in Scotland since 1961 are shown in Figure A4.

Economic value and employment

Coast protection and flood defences protect property, land and infrastructure, for example, the Scottish Environment Protection Agency (SEPA) estimate that around one in 22 houses and one in 13 businesses are at risk from coastal flooding in Scotland[50]. There is no known estimate of the economic value of the coastal protection and flood defences themselves, but the value of flood damage can be used to estimate the value

[47] United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp

[48] CREW, 2017. Dynamic Coast - National Coastal Change Assessment: Defence Asset Database

[49] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[50] SEPA, 2011. The National Flood Risk Assessment. Scottish Environment Protection Agency, Edinburgh.

protected. In the 2015 Strategic Environmental Appraisal of SEPA's FRMS it was estimated that the annual damage from coastal flooding was £52.9 million[51] , and the annual amount was expected to increase in the future due to climate change[52].

The number of jobs associated with this sector is difficult to assess accurately due to the many sectors that could be involved in coast protection and flood defence works[53].

Future trends

Future sea level rise and the potential for increasingly severe storm events due to climate change may place Scotland's coastal infrastructure and habitats under increasing threat and hence increase the economic importance of this sector[54]. The Flood Risk Management (Scotland) Act, came into force in November 2009 and introduced legislation that implemented a framework for a co-ordinated and sustainable approach to flood risk management in Scotland, with future trends taken into account. The first National Flood Risk Assessment (NFRA) was conducted in 2011[55], and is reviewed every 6 years. The NFRA is a high-level analysis of the potential economic, social and environmental impacts which could result from flooding in Scotland. Within the first NFRA, areas that are at a high risk of flooding were classed as Potentially Vulnerable Areas (PVA). The second NFRA was completed in 2018[56], and identified more areas that need protection against future flood risk.

The Flood Risk Management (Scotland) Act 2009 introduced a requirement for regional FRMS so flood protection can be dealt with at a local level. In December 2015, 14 local FRMS were published which set out how flood risk will be managed, coordinated, funded and delivered between 2016 and 2022. Each FRMS identified schemes that could be implemented to reduce the flood risk of the PVAs. A total of 42 suggested schemes were put forward to reduce potential flood risk to the PVAs[57].

A.4.3 Assumptions on Future Activity

Within each FRMS potential schemes were suggested that could be implemented to reduce flood risk to the PVAs. These schemes will be considered within the timeframe of the current FRMS (2016-2022), with new schemes potentially put forward in the next set of FRMS.

None of these schemes fall within the pMPA boundaries, and currently available data (Eurosion database) suggests that there are low numbers of coastal defences not associated with ports and harbours, within the pMPA boundaries. It has therefore been

[51] SEPA, 2015. Strategic Environmental Assessment: Flood Risk Management Strategies. Environmental Report – consultation [online] Available at: www.sepa.org.uk/media/163415/sea_environmental_report.pdf

[52] ClimateXChange, 2016. How is climate change affecting flooding of buildings and infrastructure? [online]. Available from: www.climatexchange.org.uk/media/2348/narrative_flooding_and_infrastructure.pdf

[53] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[54] ibid

[55] SEPA, 2011. The National Flood Risk Assessment. Scottish Environment Protection Agency, Edinburgh

[56] SEPA, 2018. National Flood Risk Assessment Story Map [online] Available at: https://sepaweb.maps.arcgis.com/apps/Cascade/index.html?appid=323aefe6abcf4f859acabca202c30f9b

[57] SEPA, 2016. Prioritised flood protection schemes [online] Available at: www.sepa.org.uk/media/163528/42-flood-protection-schemes.pdf

assumed that there will be a requirement to replace or maintain one area of coastal defence in each of SOH, STR and NEL pMPAs every five years.

A.4.4 Potential Interactions with pMPA Features

There are no current coastal protection assets within the pMPAs. However, activity associated with coast protection could, were it to occur, impact on pMPA features in the following ways.

The impacts of the construction of coastal protection and flood defence on pMPA features include the potential for construction to produce noise, particularly where piling activities are required, which may impact on cetacean and fish receptors, although significant impacts are considered unlikely.

In addition, the footprint of the coastal defences, should they overlap seawards of the current land-sea boundary have the potential to affect small areas of intertidal habitats, both through direct footprint and through changes to hydrodynamic and sediment regimes[58].

A.4.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Follow existing best practice mitigation measures / guidance and licensing process;
- Additional assessment to support planning and licence applications for maintenance of existing/construction of new flood protection or coast defences within pMPAs;
- No noisy activities during minke whale and basking shark high season (April-October) (SOH, STR);
- No noisy activities during Risso's dolphin high season (May-October) (NEL); and
- Minimise footprints of development to limit disturbance to burrowed mud (STR) and sandeel habitats (STR, NEL, SOH).

Where the pMPAs overlap with existing designated sites, it is possible that existing or planned management measures will contribute to achievement of the conservation objectives for the pMPAs. Assumptions on the management scenarios assessed are presented in Appendix D. The site assessments (Appendix C) provide further information on how these assumptions have been applied to individual sites.

[58] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

A.4.6 Assessment Methods

Follow existing best practice mitigation measures / guidance and licensing process

Existing best practice mitigation measures, guidance and the licensing process are already followed, and therefore there is no additional cost to this management measure.

Additional assessment to support planning applications

There are no coastal defence works within or adjacent to the MPAs identified within data contained within the Eurosion database and Scotland's Marine Atlas (Baxter et al. 2011). However, there are thought to be some coastal protection assets and therefore it has been assumed that there will be one application submitted for additional work on coastal protection within each of NEL, SOH and STR pMPAs every five years throughout the assessment period.

It is assumed that each asset requires maintenance or construction works once every 20 years. It has been assumed that these applications will require additional assessment of the potential impacts to features (and sub-features) proposed for protection, as required under the Marine (Scotland) Act 2010. This information would either be reported within the EIA if required, or as a separate MPA assessment. The cost of undertaking the additional assessment to support each planning application is estimated at £5,600 (at 2019 prices). For the purposes of this assessment, it is assumed that these assessments are carried out in 2029.

Timing of construction activity to avoid impacts to protected features

It has been assumed that these seasonal restrictions can be accommodated without imposing any additional cost on the construction programme. This is likely to be the case for all minor works.

Minimise footprints of development to limit disturbance to burrowed mud and sandeel habitats

Coastal protection works will not impact burrowed mud or sandeel habitats, as the works will be confined to areas around the mean high water mark, whilst the habitats are found in areas of deeper water.

A.4.7 Limitations

- Spatial data on the location of coast protection and flood defence structures is of poor quality;
- Uncertainty concerning future maintenance and new construction requirements; and
- Uncertainty concerning the impact of seasonal restrictions on construction costs.

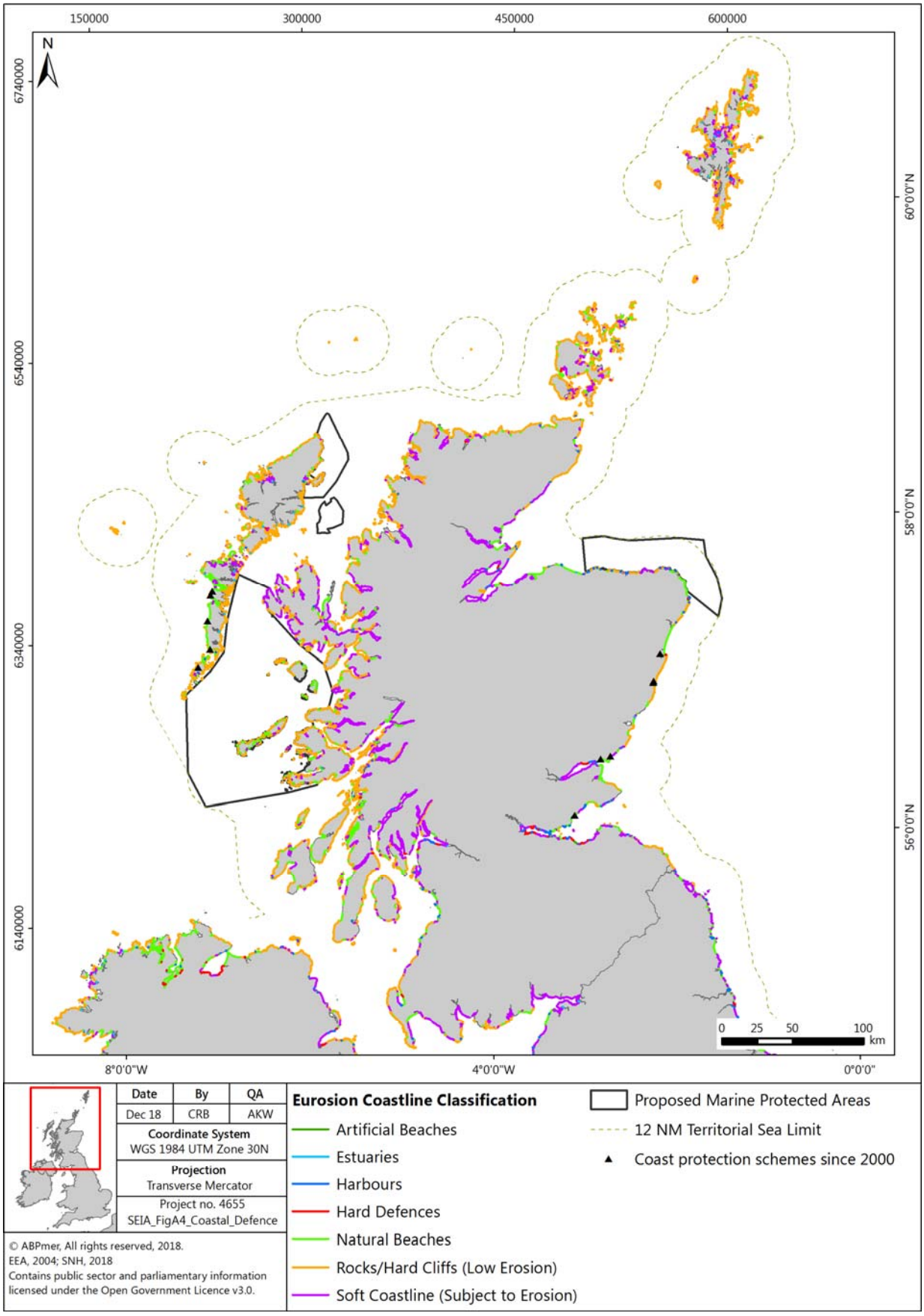


Figure A4 Coastal classification, including areas of coastal defence in Scotland

A.5 Commercial Fisheries

A.5.1 Sector Definition

For the purpose of this study, commercial fisheries relate to all commercial fishing activity within Scottish waters and includes the subsequent handling and processing of catches. In this study, commercial fishing activity includes wild salmon and sea trout fisheries, as well as cultivated shellfish beds.

A.5.2 Overview of Existing Activity

Information sources used in the assessment are listed in Table A5.

Table A5 Commercial fisheries information sources

Scale	Information Available	Date	Source
Scotland	Distribution of under-15m vessel activity (ScotMap)	2007–2011	Marine Scotland, 2015
Scotland	Vessel monitoring system (VMS) data for over-15m vessels 2012-16. Individual pings with associated landings values from landings returns, broken down by gear type	2012-2016	Marine Scotland
Scotland	Volume and value of landings by ICES rectangle (over- and under- 12m vessels)	2012-2016	Marine Scotland
Scotland	Summary of fishing activity in Scotland	2005-09	Baxter et al. 2011
Scotland	Scottish Sea Fisheries Statistics	2016	Marine Scotland, 2017
UK Fleet	Economic performance of fleet segments	2012-2016	Seafish, 2017
Scotland	Scottish Input-Output multipliers	2015	Scottish Government, 2018
UK	Seafood Processing Industry Report	2016	Seafish, 2016

Location and intensity of activity

Fish Catching Activities

In 2016, Scottish vessels landed 453,000 tonnes of sea fish and shellfish into the UK and abroad, with a gross value of £557 million (Marine Scotland, 2017). These landings constituted 65 % of the quantity, and 59 % of the value, of all landings by UK vessels

into the UK and abroad (MMO, 2017). Compared to 2015 this represented a 25% increase in value in real terms, and 3% increase in the tonnage landed. The overall trend over the last ten years has been of increasing value of landings, with a significant increase in volume of landings since 2014 from the pelagic sector (Figure A5).

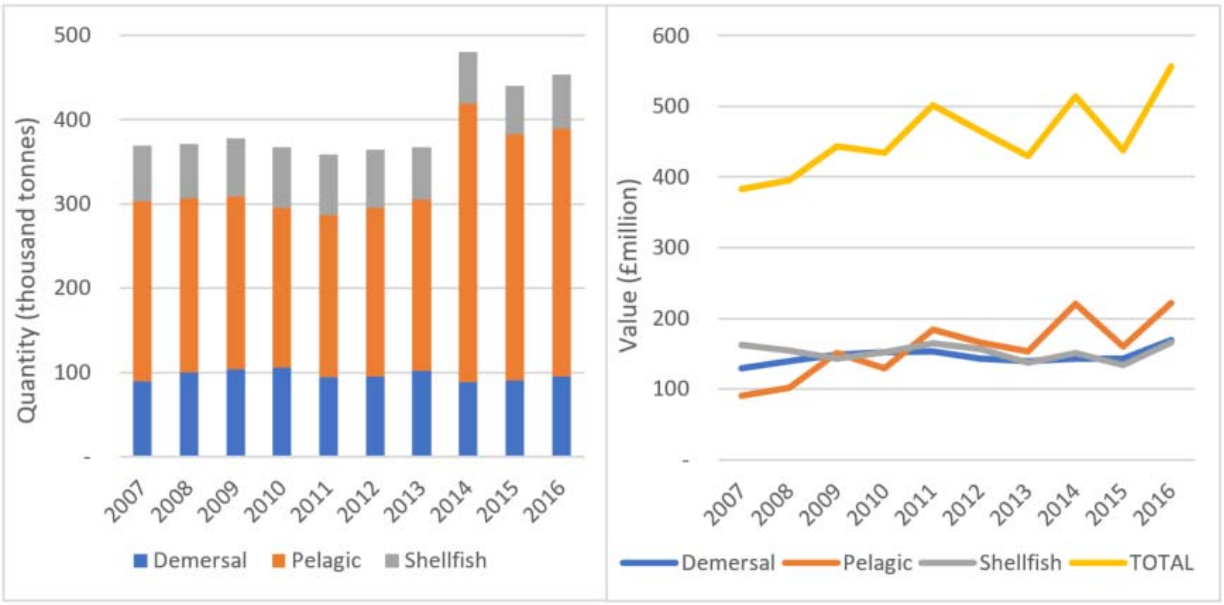
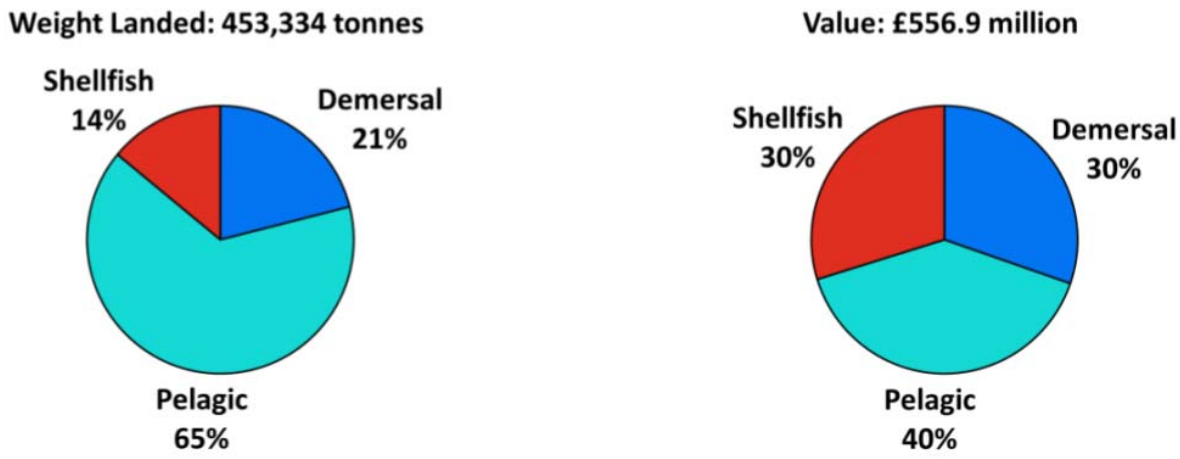


Figure A5 Trends in volume of landings (left) and value of landings (right) by Scottish vessels to the UK and abroad

Source: Compiled from Marine Scotland, 2018; Marine Scotland, 2013b.

The pelagic species mackerel and herring are of particular importance to the Scottish fleet and in 2016, these species (together with blue whiting and horse mackerel) made up 65% by volume and 40% (£222 million) of the total value of landings made by Scottish vessels. Demersal species (including haddock, monkfish and cod) made up 21% by volume and 30% by value of landings by Scottish vessels, with a total value of £169 million. Shellfish landings (including *Nephrops,* scallops, crabs and lobsters) made up 14% by volume and 30% by value of all landings by Scottish vessels with a total value of £166 million (Marine Scotland, 2017), see Figure A6.

Mackerel is the single most valuable species to the Scottish fishing industry at £169 million (30% of the total value of Scottish landings in 2016) followed by Nephrops at £77 million (14% of the total value of Scottish landings in 2016). Herring (£44 million), haddock (37 million) and scallops (£37 million) were the next most valuable species landed by Scottish vessels in 2016 (Marine Scotland, 2017).



Source: Marine Scotland, 2017.

Figure A6 Quantity and Value of Landings by Scottish Vessels, by Species Type (2016)

Figure A7 shows the distribution of the value of demersal, pelagic and shellfish landings by the UK fleet, by ICES rectangle in 2016. Important areas for demersal fisheries are along the continental shelf edge and in the northern North Sea east of Orkney and Shetland.

Pelagic catches are similarly distributed along the continental shelf edge and north and east of Scotland. Much of this is dependent on catches of mackerel, the most valuable species to the Scottish fleet. Fishing grounds for mackerel can vary on an annual basis depending on the time of movement of the stock, catching opportunities (TAC), weather, marketing conditions and opportunities and the activity of other countries' fleets.

In contrast, shellfish landings are predominantly from inshore areas, particularly around the west coast, but with some important areas also on the east coast.

Figure A8 shows an overview of the spatial distribution of the value of landings from over-15 m UK vessels. There are important fishing areas in inshore areas on the west coast, along the shelf edge, around Shetland and across the North Sea. Under-15 m vessel activity tends to be concentrated in inshore areas within 12 nm and close to vessels' home ports (Figure A9).

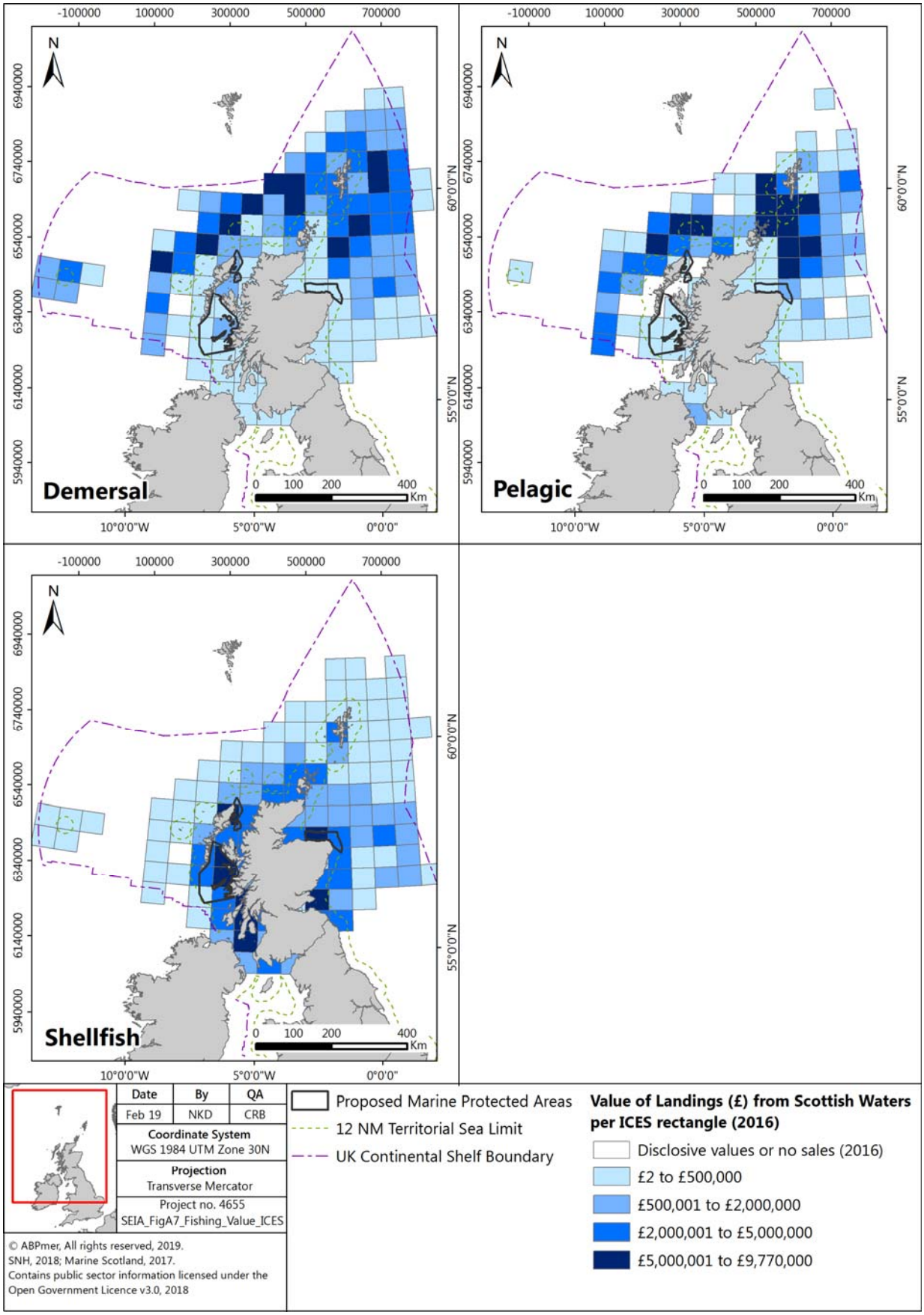


Figure A7 Value of demersal, pelagic and shellfish landings from UK vessels by ICES rectangle, 2016

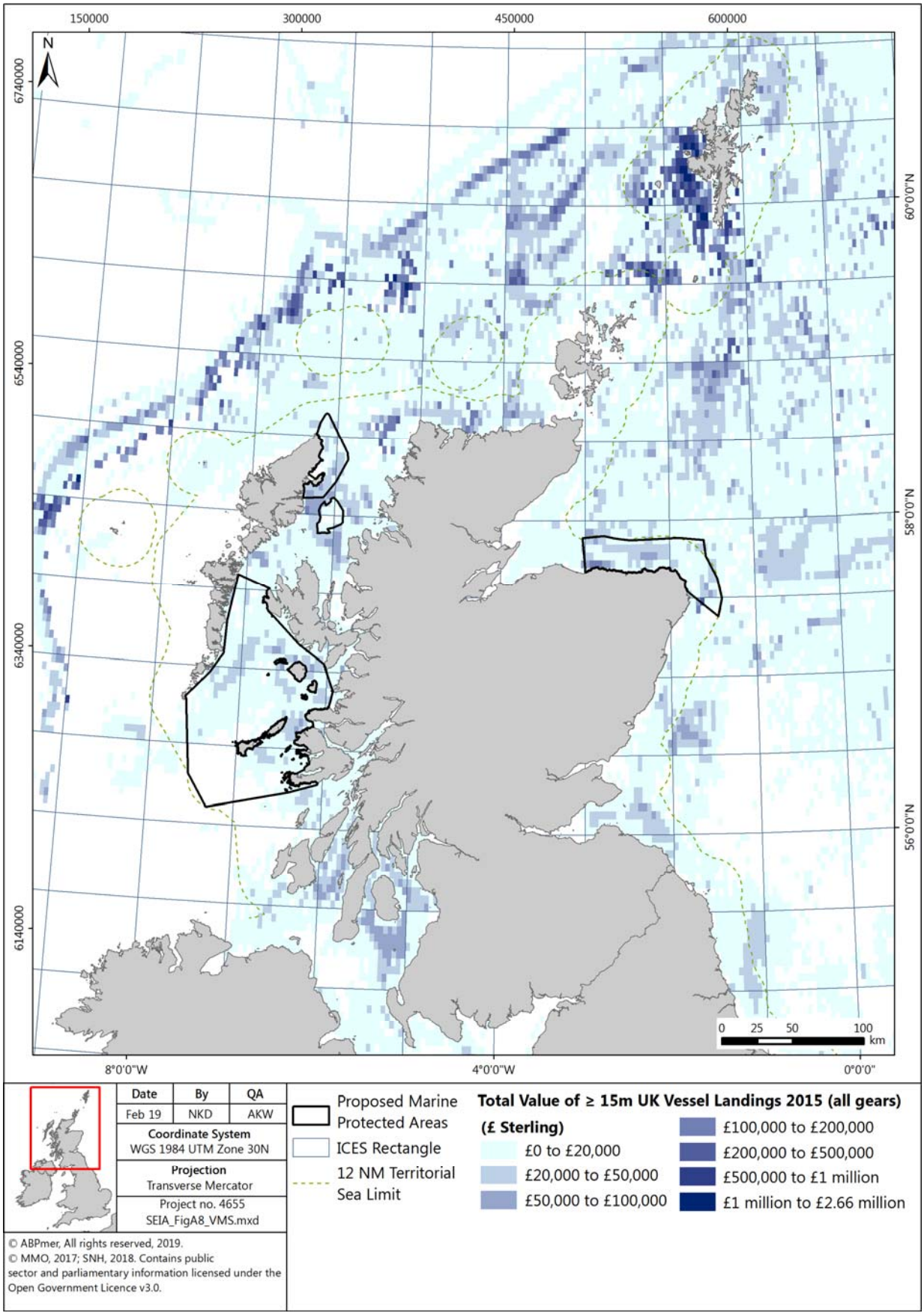


Figure A8 Value of landings from over-15 m UK vessels)

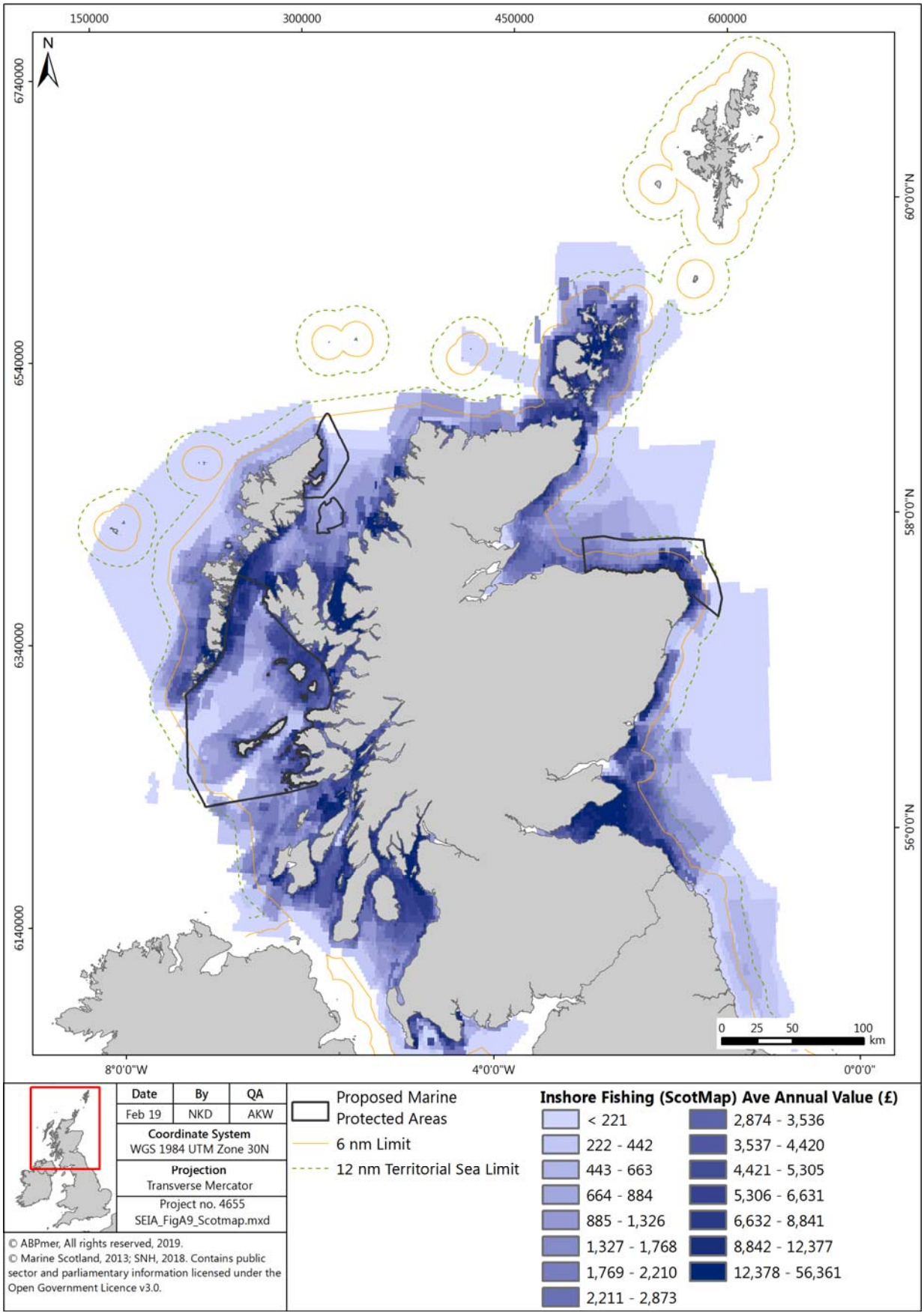


Figure A9 Value of landings from under-15 m vessels from ScotMap

Note: ScotMap does not cover the Shetland region.

In 2016, 72% of the total value and 62% of the total volume of landings by Scottish vessels were landed into Scottish ports. Around 3% by value was landed to ports in the rest of the UK, with 24% by value landed abroad (£133 million). The majority of landings abroad were into Norway, and nearly all of these landings were pelagic species (predominantly mackerel) (Marine Scotland, 2017). Other key countries for landings abroad were to Denmark (mainly pelagics), Ireland (pelagics, demersal and shellfish), the Netherlands and Spain (mainly demersals) (Marine Scotland, 2017).

There were 349,000 tonnes of fish and shellfish landed into Scotland (by all vessels) in 2016, worth £506 million. Demersal species accounted for 46%, shellfish 30% and pelagic species 24% of the value (Marine Scotland, 2017). Landings into ports in the south-west and south-east were dominated by shellfish, while landings into the north-west coast were of both demersal and, to a lesser extent, shellfish species (Figure A10). The three largest districts in Scotland in terms of quantity and value of landings were Peterhead (east coast), Shetland (north) and Fraserburgh (east coast). These districts receive landings of all three species types, although Peterhead and Shetland receive relatively small amounts of shellfish compared to demersal and pelagic species.

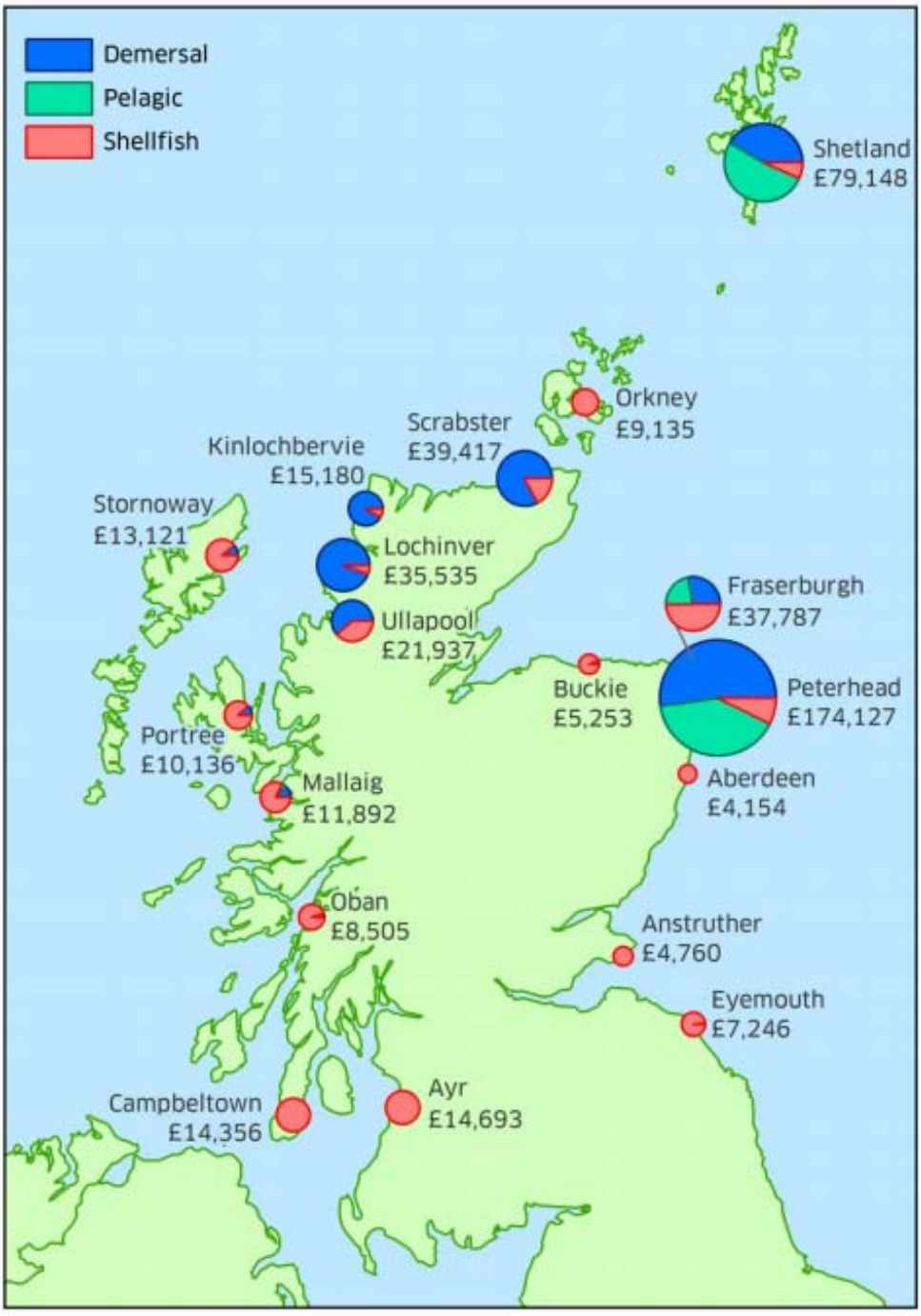


Figure A10 Value of landings into Scottish ports by all vessels by district (£ thousand, 2016)

Source: Marine Scotland, 2017[59].

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

The Scottish Fishing Fleet

The number of active Scottish based vessels increased to 2,033 vessels in 2016, representing a 0.9% increase (19 vessels) since 2015 and a 7% decrease (160 vessels) since 2007 (Marine Scotland, 2017). The Scottish fleet is dominated by vessels with a length of ten meters and under, with 72% of vessels falling into this category. The over-ten meters fleet comprised 569 vessels in 2016 (Marine Scotland, 2017).

Stornoway and Fraserburgh are the two largest districts in Scotland in terms of the number of vessels (Figure A11). In 2016, these two districts accounted for 20% of the Scottish fleet (208 vessels in Stornoway and 207 in Fraserburgh). The fleet in these districts is dominated by under-10m vessels (over 75% of the fleet in Stornoway and 55% in Fraserburgh) (Marine Scotland, 2017).

Wild Salmon and Sea Trout

Scotland is famous for its wild salmon *Salmo salar* and sea trout *Salmo trutta*. These fish hatch in rivers, migrate to sea then return as adults to spawn. Marine migrations in salmon are generally more extensive than those of sea trout.[60]

All salmon fishing and sea trout fishing rights in Scotland, including in the sea, are private, heritable titles, which may be held separately from any land. They fall into one of three broad categories:

- Fixed engine fisheries - are restricted to the coast and must be set outside estuary limits;
- Net and coble fisheries - generally operate in estuaries and the lower reaches of rivers; and
- Rod and line fisheries - generally operate within rivers and above tidal limits.

Salmon and sea trout fishing takes place within estuaries or on the coast, and no management measures or cost impacts are anticipated for wild salmon and sea trout fisheries as a result of the establishment of pMPAs in Scottish waters.

[60] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

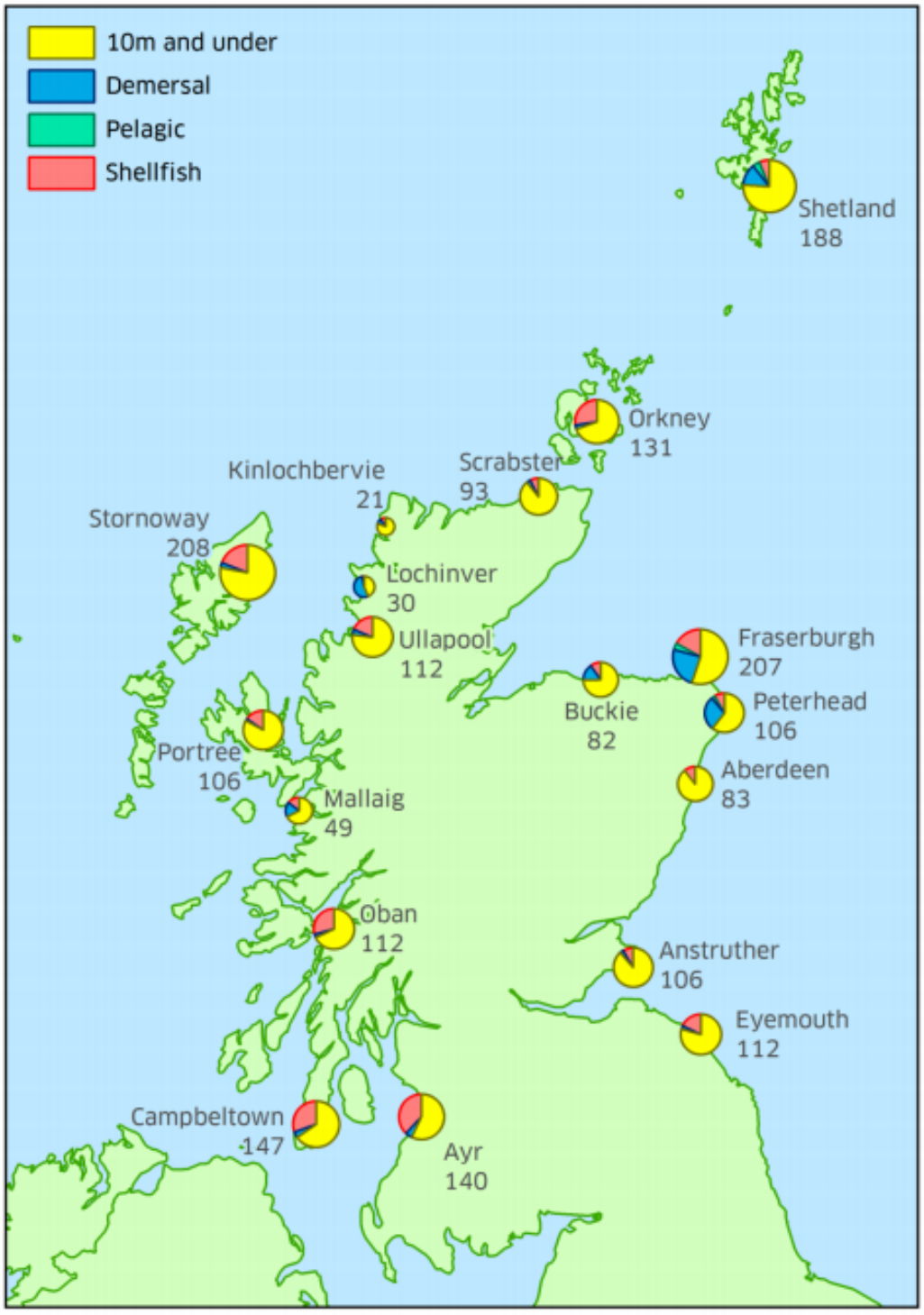


Figure A11 Number of vessels in the Scottish fleet by district

Source: Marine Scotland, 2017[61].

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

Economic value and employment

Fish Catching Activities

Scotland is one of the largest sea fishing nations in Europe and the fishing industry is of economic, social and cultural significance to Scotland and its coastal and island communities.

The number of fishermen employed on Scottish based vessels was 4,823 in 2016 (Table A6), representing 0.2% of the labour force in Scotland (Marine Scotland, 2017). This has remained constant from 2015 to 2016. Some 3,834 of these were regularly employed, 938 were irregularly employed (formerly referred to as part-time) and 51 were crofters (Marine Scotland, 2017). Aberdeenshire had the highest number of fishermen at 1,207. The 'Islands' group (Western Isles, Orkney and Shetland) together accounted for 22% of employment in fishing.

Although commercial fishing makes a relatively low contribution to Scotland's overall GDP and labour force, fisheries employment is highly concentrated into relatively few areas, and for these areas the fisheries sector is considerably more important than for Scotland as a whole. It is a particularly important socio-economic activity in remote coastal regions in Scotland. In the Western Isles, Orkney and Shetland region, for example, employment in fishing as a percentage of the labour force was 2.8% in 2016 (Marine Scotland, 2017).

In 2016, fishing generated £296 million Gross Value Added (GVA), accounting for 0.2% of the overall Scottish economy, and 8% of the marine economy.[62] From 2015 to 2016, GVA increased by 34% (adjusted to 2016 prices), while the longer term trend from 2008 to 2016 increased by 63%. The highest GVA by district was generated in Aberdeenshire (£131 million), the Shetland Islands (£72 million), Highland (£30 million) and Argyll and Bute (£14 million).[63]

Fish Processing Activities

There were 152 fish processing sites in Scotland in 2016 (for the processing of saltwater (sea fish) and salmon & freshwater fish)[64]. The majority of these (39%) were in the Grampian region, with 23% in Highlands and Islands, and the remainder in 'Other Scotland'.

The fishing industry, together with aquaculture production and imported fish, provide inputs to the processing industry. The fish processing sector provided 8,380 full-time equivalent (FTE) jobs in Scotland (Table A6), a decline of 12% since 2008. GVA of the sector was £341 million in 2014. Over half of UK processing sites for salmon and freshwater fish processing are in Scotland. Of the 3,606 FTEs in the salmon and

[62] 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.

[63] Marine Scotland, 2018. Ibid.

[64] Seafish, 2017. 2016 Seafood Processing Industry Report. Available at: http://www.seafish.org/research-economics/industry-economics/processing-sector-statistics. Accessed 22.10.18.

freshwater fish processing sector in Scotland, 68% were in 'Other Scotland' and 23% in 'Highlands and Islands', making it particularly important in rural locations.

Whilst the majority of landings and fish processing occur in the Grampian region (northeast), the fishing and processing industries provide an important contribution to local economies in rural and island communities, particularly in Orkney, Shetland and the Western Isles.

Table A6. Output, GVA and employment for fishing and processing for Scotland and the rest of UK

	Sector	Scotland	Rest of UK	Total	Source
Output (£m)	Fishing (2016)	557	379	936	MMO, 2017[65]
	Processing (2014)	2,038	2,357	4,395	Seafish, 2016[66]
GVA (£m)	Fishing (2016)	296	171	467	Marine Scotland, 2018[67]
	Processing (2014)	341	435	776	Seafish, 2016[68]
Employment	Fishing (2016)	4,823	6,934	11,757	MMO, 2017[69]
	Processing (2016)	8,380	9,619	17,999	Seafish, 2016[70]

Future trends

Fish Catching Activities

Fishing activity changes in response to a number of factors: scientific advice; the location of fish; policy measures such as catch limits (quotas), limits on fishing effort (days spent fishing multiplied by the power of the vessel), the need for possible closures and decommissioning schemes; and profitability. Fishing effort has decreased significantly since the 1990s due to restrictions on fishing activity in order to promote stock recovery[71]. EU controls on Total Allowable Catches (TACs) and fishing effort and decommissioning of vessels in the UK have contributed to reductions in total fishing effort in the international demersal fisheries in the North Sea, West of Scotland and Irish

[65] MMO, 2017. UK Sea Fisheries Statistics 2016. Available online at https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2016. Accessed 18 April 2018.

[66] Seafish, 2016. Seafood Processing Industry Report 2016. Available online at http://www.seafish.org/media/publications/2016_Seafood_Processing_Industry_Report.pdf. Accessed 24 April 2018.

[67] Marine Scotland, 2018. Scotland's Marine Economic Statistics. Available online at https://www.gov.scot/publications/scotlands-marine-economic-statistics/pages/16/. Accessed 10 January 2019.

[68] Seafish, 2016. Ibid.

[69] MMO, 2017. Ibid.

[70] Seafish, 2016. Ibid.

[71] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

Sea[72] (UKMMAS, 2010). In recent years, stocks have been recovering and quotas have been rising in response.

The Government's White Paper on Fisheries, published on 3 July 2018, sets out the intention for the UK to become an independent coastal state under the UN Convention on the Law of the Sea (UNCLOS), with rights and responsibilities to manage the resources in its waters, when it leaves the European Union. This includes the intention to move away from Relative Stability quota shares under the Common Fisheries Policy towards 'a fairer and more scientific method for future TAC shares as a condition of future access'. This implies shares that better reflect the resources in UK waters, and has the potential to result in increased quotas for some species for UK and Scottish vessels. The EU is an important market for Scotland's fish and shellfish landings and Brexit has the potential to impact on tariff and non-tariff measures in seafood trade. However, the outcome of the Brexit process and UK and Scottish fisheries policies post-Brexit remain uncertain. The fisheries sector is currently, and is likely to remain, important to many rural areas in Scotland. Fisheries are potentially impacted by both environmental and anthropogenic factors, including:

- Climate change effects (warming seas), which may result in the decline of stocks of cold-water species, such as cod, in waters around the UK as the stocks move northwards. However, new opportunities for warmer-water species may emerge as these species extend northwards into UK seas; Existing more southerly stocks such as red mullet, John Dory and bass may also experience improved productivity in years with higher average sea temperatures[73];
- Anthropogenic effects such as permanent structures, dumping at sea, oil and chemical spills, and the effects of the fisheries themselves, which may impact on the habitats where the fish live; and
- Profitability and political effects.

A.5.3 Assumptions on Future Activity

The baseline review did not identify any clear future trends for commercial fisheries. Future policies and the response to those policies remain difficult to predict therefore this assessment has assumed that the location and intensity of commercial fisheries activities do not change significantly over the period of the assessment. This assumption is consistent with that adopted for the Marine Conservation Zones (MCZs) in England which assumed the spatial distribution and value of landings would remain constant over the 20-year timeframe of the assessment, due to the lack of micro-scale

[72] UKMMAS, 2010. Charting Progress 2: Productive Seas Evidence Group Feeder Report. Published by Defra on behalf of UKMMAS.

[73] UKMMAS, 2010. Ibid.

forecasts of future activity[74]. It is also consistent with the analysis of the socio-economic impacts of other MPAs in Scottish inshore and offshore waters.[75,76,77]

A.5.4 Potential Interactions with pMPA Features

The principal impacts to proposed new pMPA features from commercial fisheries activity include:

- Habitat damage as a result of mobile gears being drawn across the seabed;
- By-catch of marine mammals within nets and in ropes or lines; and
- Visual or noise disturbance of fish or marine mammals.

Habitat damage principally relates to dredges and trawls (otter trawls for whitefish and *Nephrops*, beam trawls, mechanical and suction dredges). Demersal seine nets are also drawn across the seabed and may cause damage to sensitive features, but the scale of impact is generally less than for trawled gear.

A.5.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs:

- Follow best practice to minimise risk of bycatch/entanglement of basking shark (SOH), minke whale (SOH, STR) and Risso's dolphin (NEL);
- Exclusion of hydraulic gear from specific habitats (sandeel habitat in SOH, NEL, STR; northern sea fan and sponge communities in SEB);
- Exclusion of mobile demersal (bottom-contacting) gear from a proportion of burrowed mud (STR) and circalittoral sand (SEB);
- Exclusion of drift nets and set nets, either at certain times of year (between April and October in Shark Awareness Zones or across SOH; between June and October in STR; between May and October in NEL) or all year (in southern half of NEL);
- Limit herring and sprat fishing effort to current levels (SOH, STR);
- Restriction of vessel speeds to <6 knots within the Shark Awareness Zones between June and October (SOH only).

[74] 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.

[75] 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.

[76] 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.

[77] 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.

Where the pMPAs overlap with existing designated sites, it is possible that existing or planned management measures will contribute to achievement of the conservation objectives for the pMPAs. Assumptions on the management scenarios assessed are presented in Appendix D. The site assessments (Appendix C) provide further information on how these assumptions have been applied to individual sites.

A.5.6 Assessment Methods

Follow best practice to minimise risk of bycatch/entanglement

It is assumed that best practice is already being followed, or that any adaptations would not result in any significant additional costs to fishing activities, therefore there is no additional cost associated with this management measure. Best practice to minimise risks of entanglement of marine mammals and basking sharks may involve ensuring that end ropes on static gears are adjusted to support water depth and that additional weighting is used to keep end ropes tight.

Exclusion of fishing gears from certain areas and at certain times of year (all other management scenarios above)

Assessment of the cost to the commercial fisheries sector of restriction of fishing activities is in terms of the loss of the value of landings from the area.

Step 1: Estimating the costs arising from proposed management scenarios – value of landings affected. Due to the differences in data availability, this was carried out separately for under-12 m and over-12 m vessels.

For under-12 m vessels, the value of landings affected was calculated from ICES rectangle landings data, pro-rated based on the distribution of value from Scotmap. This allows the distribution of under-12 m activity within the ICES rectangle to determine the proportion of the ICES rectangle value that comes from the management area. From Scotmap, for each ICES rectangle, the Scotmap value of landings within the management area was calculated, as well as the Scotmap value of landings from the ICES rectangle. The ratio between the two was used to pro-rata the baseline ICES rectangle landings data.

For over-12 m vessels, Vessel Monitoring System (VMS) ping data linked to landings records were used. Recorded landings in a day were allocated across all VMS fishing pings on that day, where a ‘fishing ping’ has been defined as one where the average speed since the previous ping is greater than zero and up to and including 5 knots for all gear types. VMS ping data were extracted by Marine Scotland and are estimates of landings value by area of capture. The ping data were then intersected with the management areas to calculate the value affected for each gear type.

For both under-12 m and over-12 m vessels, landings values were uprated to 2019 values using predicted GDP deflators and averaged over five years (2012-2016) to provide annual average values over the period.

All the sites, with the exception of a small part of STR, are within 12 nm and do not overlap with areas where non-UK vessels have historic access rights. The datasets used included all UK-registered vessels. Value of landings were not available for non-

UK vessels. Impacts are attributed to Scottish vessels and Scottish ports through the analysis of Home port and Port of landing.

Mobile demersal (bottom contact) gears include demersal trawls, demersal seines, beam trawls, and dredges.

Step 2: Displacement test. The assessment of the potential for displacement of fishing effort was based on the criteria in McLeod (2014)[78], which applied a step-wise process of three displacement tests. The displacement test was only applied under the lower scenario (consistent with other SEIA assessment of commercial fisheries in MPAs), however as the lower scenario assessed did not result in the loss of any landings value in any of the pMPAs, the displacement test was not applied.

The regions relevant for the commercial fisheries assessment are shown in Figure A12.

[78] McLeod, M., 2014. Scottish MPA Project – Assessing the potential levels and effect of fisheries displacement as a consequence of possible management measures for future inshore Marine Protected Areas.

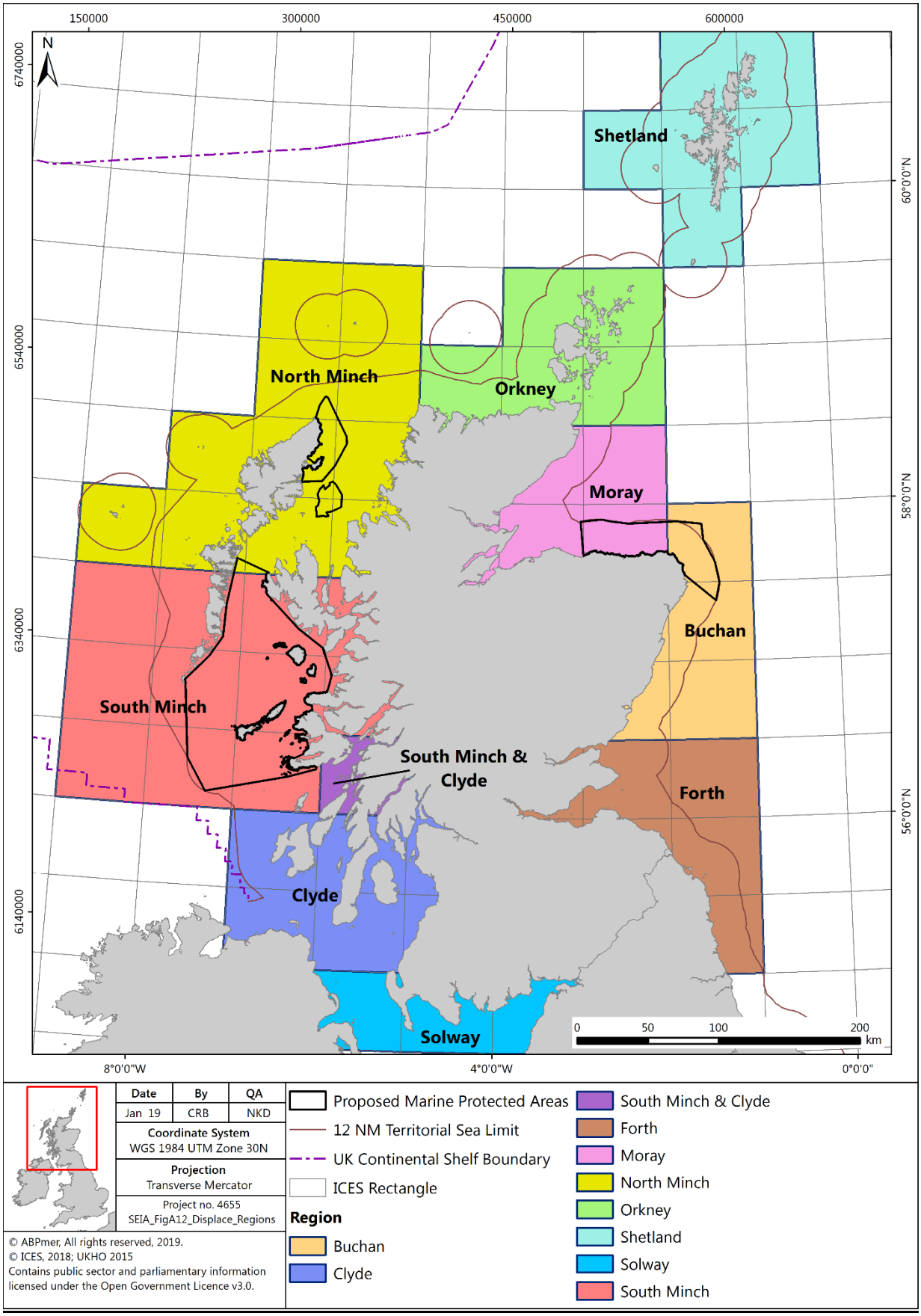


Figure A12. Inshore fishing regions and ICES rectangles

Step 3: Convert value of landings to direct GVA impact. The average annual value of landings affected was converted to direct GVA for each fleet segment using segment-specific ratios of GVA as a proportion of fishing turnover calculated from Seafish economic data (Table A7).

Table A7. GVA as a percentage of fishing income for each fleet segment

Fleet segment	South Minch & North Minch	East coast (Moray, Buchan)
Under-12 m		
Beam trawl	22%	5%
Demersal trawl	45%	42%
Demersal seine	45%	45%
Nets	55%	55%
Mechanical & suction dredges	47%	47%
Over-12 m		
Beam trawl	25%	15%
Demersal trawl	39%	37%
Demersal seine	45%	45%
Nets	54%	54%
Mechanical & suction dredges	46%	46%

Step 4: Calculate indirect and induced GVA, and employment effects. The reduction in direct and indirect GVA (i.e. reduction in GVA generated by the sector and its supply chain) was estimated by applying the Type I GVA multiplier for sea fishing from the Scottish Government's Input-Output Tables and Multipliers[79]. The reduction in direct, indirect and induced GVA (i.e. reduction in GVA generated by the sector and its supply chain and the knock-on impacts of a change in household consumption) was estimated by applying the Type II GVA multiplier for sea fishing from the Scottish Government's Input-Output Tables and Multipliers[80]. Reductions in direct and indirect employment, and in direct, indirect and induced employment, were estimated by applying the Type I and Type II employment effects, respectively, for sea fishing from the Scottish Input-Output Tables and Multipliers.

Step 5: Calculate the present value of impacts over the assessment period. The average annual value of landings affected is assumed to be constant throughout the 20-year period of the assessment. Costs are calculated in 2019 prices, discounted over the assessment period at a rate of 3.5%[81].

[79] Scottish Government, 2017. Input-Output Tables 1998-2014 (Latest year 2014), revised 26 July 2017. Available at http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output.

[80] Scottish Government, 2017. Ibid.

[81] 3.5% rate used based on HM Treasury Green Book Guidance (2017). Discounting is the technique of applying a discount rate to convert future monetary amounts to their equivalent value in today's terms, (based on the premise that people prefer to receive benefits in the present rather than in the future).

Step 6: Disclosure analysis. It is not permitted, for reasons of confidentiality, to disclose data on annual landings values that represent five or fewer vessels. In these cases, the value of affected gear types were aggregated together for presentation of results. In NEL pMPA, five vessels or fewer were affected by the scenarios, therefore the value affected has not been presented. However, the value affected is very low and does not affect the overall total for the 4 pMPAs.

Step 7: Identify and document other non-quantified costs and benefits. Other costs and benefits that may arise from the management scenarios, but that have not been quantified, were identified and recorded in the Site Reports (Appendix C).

Another supply chain that is highly relevant to commercial fishing vessels is that which the vessels input to, that is, the supply of fish to processing facilities and to the wholesale and retail trades. Impacts on this sector are explicitly considered in the site assessments where relevant. The potential impacts on GVA and employment in the processing sector have not been quantified separately. This is because the relevant multipliers link the sector back to its inputs, which include the commercial fishing sector. Therefore, estimating the reduction in the processing sector would also estimate the reduction in the commercial fisheries sector as an indirect effect and hence would result in double counting.

Limit herring and sprat fisheries to current levels

The assessment is carried out against a baseline assuming current level of activity. Therefore limiting herring and sprat fisheries to current levels has no cost impacts for the sector.

Restriction of vessel speeds to <6 knots in Shark Awareness Zone

Fishing activity generally takes place at speeds below 6 knots, therefore the restriction of vessel speeds only has the potential to affect steaming time. The Shark Awareness Zones do not overlap with major fishing vessel steaming routes (they are not in the vicinity of the key landing ports of Oban, Mallaig or Portree). For vessels that need to cross the zones, the distance is approximately 20 km (in some locations, considerably less depending on the direction of travel) or 10 NM. For a vessel travelling at 6 knots rather than 10 knots, this implies an additional 40 minutes steaming time on a one hour traverse, however there is potential for this to be reduced by detouring around, or reducing transit distance within, the zones.

There are some under-10m vessels with their home port on Coll and Tiree that could be affected by the speed restrictions as they leave port (fewer than five vessels[82]). Depending on their fishing location, they would travel 2.5 NM to leave the Shark Awareness Zone, implying an extra 7 minutes' steaming time (assuming normal steaming speed is 8.5 knots for an under-10m vessel[83]). If fishing around the islands of

[82] Seafish, no date. Map showing fishing vessels by home port, 2015. Primary data sources Sea Fish Industry Authority and Marine Management Organisation.

[83] MAIB, 2006. Report on the investigation of the capsize and loss of the 9.8m stern trawler Bounty 4 miles off Berry Head, South Devon on 23 May 2005. Marine Accident Investigation Branch Available online at https://assets.publishing.service.gov.uk/media/547c709640f0b602410000bb/Bounty.pdf

Coll and Tiree they might travel longer distances within the zone, implying greater additions to steaming time.

Overall, there is assumed to be no cost associated with these speed restrictions, as the zones do not affect key steaming routes and only a small number of vessels may be affected. Travelling at lower speeds also reduces fuel consumption and will reduce fuel costs.

A.5.7 Limitations

- 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 activity in 2007, 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. The Scotmap 'All gears' value layer was used to derive the proportions, which may over- or under-estimate the value for specific gears in some sites. Additionally, Scotmap was based on a survey which had low coverage in some regions, including Mallaig, Oban and Buckie which are relevant to the pMPAs. Fraserburgh, Peterhead and Stornoway had higher coverage levels (80% or above).
- 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.
- The classification of gear types relies on the information reported in logbooks. Some gears may be wrongly classified, in particular mechanical dredges (DRB) may be classified as mechanised (suction) dredges (HMD).
- 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 estimate, it was assumed that the value of landings affected would be 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.
- As the value of future landings cannot be forecast, it is assumed that the value of landings is 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 IA. 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.

- 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. This means that where fishing effort has been displaced from phase 1 MPAs to pMPAs, the cost impact will be underestimated. Similarly, displacement of fishing effort resulting from the construction of Beatrice windfarm will not be fully captured in the data used for the assessment.
- The quantification of cost impacts to the sector is restricted to UK vessels, as data on non-UK vessels were not available to allow assessment of impacts.

A.6 Energy Generation

A.6.1 Sector Definition

The energy generation sector includes conventional energy generation (coal, gas, nuclear, etc.) as well as offshore renewables (offshore wind, wave and tidal). In addition to the power generation assets themselves, it also incorporates supply chains for renewables along with transmission capacity.

A.6.2 Overview of Existing Activity

Information sources used in the assessment are listed in Table A8.

Table A8 Energy generation information sources

Scale	Information Available	Date	Source
Scotland	Amount of electricity generated by energy source in Scotland (Scottish Environmental Statistics Online)	2004-2016	Scottish Government Energy Statistics Database (2018)
Scotland	National Renewables Infrastructure Plan	2010	Scottish Enterprise and Highlands & Islands Enterprise (2010a; 2010b)
Scotland	Draft Sectoral Marine Plan for Offshore Wind Energy (encompassing Deep Water Plan Options) – Context Report	2018	Scottish Government (2018)
Scotland	Potential Development Scenarios for Scottish Offshore Wind Supply Chain	2010	Scottish Renewables (2010)
Scotland	Scotland's Offshore Wind Route Map – Developing Scotland's Offshore Wind Industry to 2020 and beyond	2013	Offshore Wind Industry Group
Scotland	The Offshore Valuation – A valuation of the UK's offshore renewable energy resource	2010	Public Interest Research Centre on behalf of The Offshore Valuation Group (2010)
Scotland	Scottish Offshore Wind: Creating an Industry to Scottish Renewables	2010	IPA Energy + Water Economics (2010)
Scotland	The Wave and Tidal Resource of Scotland	2017	Neill et al (2017)
Scotland	Scottish energy strategy: the future of energy in Scotland	2017	Scottish Government (2017)
Scotland	Scottish Renewable Energy Generation Capacity	2018	Scottish Renewables
Scotland	Scottish and Southern Energy plc Annual Report 2018	2014	Scottish and Southern Energy (2018)

Scale	Information Available	Date	Source
Scotland	Scottish and Southern Energy plc Annual Report 2018	2018	Scottish and Southern Energy (2011)
Scotland	Existing wind farm locations	Current	Marine Scotland
Scotland	Scotland's National Marine Plan	2015	Marine Scotland (2015)
Scotland	Information on wave, tidal and wind energy in Scotland	2017	The Crown Estate http://www.crownestatescotland.com/the-assets/marine/asset/wave-and-tidal; http://www.crownestatescotland.com/the-assets/marine/asset/offshore-wind
Scotland	Offshore renewables and cables and pipelines activity in Scotland	2017	The Crown Estate, http://www.crownestatescotland.com/maps-and-publications
Scotland	Wind, wave and tidal lease areas in Scotland	Current	Marine Scotland NMPi https://marinescotland.atkinsgeospatial.com/nmpi/
Scotland (Pentland Firth and Orkney Waters)	Supply Chain Demand - PFOW Round 1 Wave and tidal Projects	2011	The Crown Estate (2011)
UK	The size and performance of the UK low carbon economy	2015	Department for Business, Innovation and Skills (2015)
UK	UK offshore wind supply chain: capabilities and opportunities	2014	BVG Associates (2018)
UK	Marine Renewable Energy Atlas. Direction, speed, potential output and temporal variation (gridded square)	Current	ABPmer
UK	Digest of UK Energy Statistics 2018	2018	Department for Business, Energy & Industrial Strategy
UK and Regional	Regional Renewables Statistics	2003-2016	Department for Business, Energy & Industrial Strategy
UK	Renewable Energy Planning Database	Current	Department for Business, Energy & Industrial Strategy
UK	Location of coastal power stations extracting seawater for cooling	Current	Marine Scotland National Marine Plan interactive (NMPi)
UK	2017 Electricity Ten Year Statement	2017	National Grid (2017)

The total amount of electricity generated in Scotland in 2016 was 45,845 gigawatt hours (GWh), down from 51,352 GWh in 2015. However, over the past decade the total generated has remained reasonably stable, with a high in 2013 of 53,040 GWh and a low in 2016[84].

Renewable energy generation was 19,676 GWh in 2016, representing 42.9% of the total energy generation in Scotland[85].

Conventional electricity generation

At the end of August 2018, the following three major coastal power stations were in operation in Scotland:

- Hunterston B in west Scotland: a nuclear power station commissioned in 1976 (current total supply to the national grid is 965 megawatts (MW); EDF Energy website);
- Torness in east Scotland: a nuclear power station commissioned in 1988 (current total supply to the national grid is 1,190 MW; EDF Energy website); and,
- Peterhead in north-east Scotland: a gas/oil power station originally commissioned in 1980 (current total capacity of 1,180 MW; SSE Capacity Market Factsheet).

Hunterston B is due to be decommissioned in 2023[86] and Torness is to be decommissioned in 2030 at the earliest. The locations of existing operational coastal power stations are shown in Figure A13.

Offshore renewable energy

Offshore renewable energy sources currently exploited include offshore wind, wave and tidal energy.

Offshore Wind

Scotland currently has five operational offshore wind sites with a total capacity of 320 MW: the Beatrice demonstrator project (two 5 MW turbines, currently undergoing decommissioning), the Hywind Scotland Pilot Park project (30 MW capacity), Robin Rigg (180 MW capacity), Levenmouth Demonstration Turbine (one 7MW turbine) and, during 2018, the European Offshore Wind Deployment Centre deployed 11 turbines, with a total capacity of 93.2 MW.

While the number of operational developments is small, within Scottish Territorial Waters, there are currently plans to install up to 1.9 GW capacity of offshore wind in three short-term option sites (Beatrice, Inch Cape and Neart na Gaoithe), together with up to 4.15 GW capacity within two Round 3 sites in offshore waters (Moray Firth

[84] Scottish Government, (2018). Energy Statistics Database.

[85] ibid.

[86] EDF Energy, (2018). https://www.edfenergy.com/energy, [accessed 02/10/2018].

(1.7 GW) and Firth of Forth (2.45 GW)). All five of these major offshore wind developments in Scottish waters were consented in 2014.

The Beatrice project is currently under construction and is expected to reach full operation in 2019 with a capacity of 588 MW.

Tidal Stream and Wave Energy

The Meygen project is currently under construction in Pentland Firth. Phase 1 installed four 1.5 MW turbines, now operational, as a precursor to the development of the remaining consented 86 MW project[87] and potential future expansion[88].

The European Marine Energy Centre (EMEC) provides a range of testing facilities for wave and tidal devices around Orkney. Operational devices are currently being tested at the Billia Croo (wave energy), Scapa Flow (wave energy), Fall of Warness (tidal stream energy) and Shapinsay Sound (tidal stream energy) sites. The Islay LIMPET wave device was the world's first commercial wave power device connected to the United Kingdom's National Grid. Following the construction of a 75 kW prototype in 1991, a 500 kW unit was built in 2000 (later downgraded to 250 kW) and was decommissioned in 2018. The 300 kW (3 x 100 kW turbines) North Yell tidal array was installed and commissioned in early 2014 in the Bluemull Sound in Shetland; the project is 100% owned by the local community, making this the world's first community-owned tidal energy project, and there are plans to double capacity of the site.

A large number of wave and tidal developments are in development/in planning, particularly associated with the Pentland Firth and Orkney Waters lease areas and lease awards made in relation to the Saltire Prize (see Table A9). Current and planned offshore renewable energy generation sites in Scotland are presented in Figure A13.

Table A9 Operational and Planned wind, tidal and wave renewable energy projects around Scotland and within Scottish Territorial Waters as at October 2018

Energy Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Robin Rigg	E.ON https://www.eonenergy.com/About-eon/our-company/generation/our-current-portfolio/wind/offshore/robin-rigg	Fully operational since September 2010.	174
Wind	Beatrice Demonstrator	SSE Renewables / Talisman	Fully operational - entering decommissioning phase	10
Wind	Levenmouth Turbine	ORE Catapult https://ore.catapult.org.uk/press-releases/levenmouth-turbine-offers-unrivalled-opportunity-for-renewable-energy-rd/	Fully operational	7

[87] Simec, 2018. Meygen Tidal Array. https://simecatlantis.com/ [accessed 12/09/2018)

[88] The lease held by Simec Atlantic includes provision for up to 398MW of capacity.

Energy Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Hywind	Statoil / Masdar http://www.statoil.com/en/environmentsociety/environment/impactassessments/newenergy/intwind/pages/hywindscotland.aspx	Fully operational	30
Wind	Aberdeen Bay (EOWDC)	Vattenfall http://www.statoil.com/en/environmentsociety/environment/impactassessments/newenergy/intwind/pages/hywindscotland.aspx	Fully operational	93.2
Wind	Beatrice	SSE Renewables / SDIC / Copenhagen Infrastructure Partners http://sse.com/whatwedo/ourprojectsandassets/renewables/Beatrice	Under construction, expected operational 2019	588
Wind	Neart na Gaoithe	Mainstream Renewables http://www.neartnagaoithe.com	Consented December 2018	450
Wind	Firth of Forth 1	SSE Renewables / Fluor http://www.seagreenwindenergy.com	Updated application submitted June 2018. Construction to begin no later than 2022.	1050
Wind	Moray East	EDPR http://www.morayoffshorerenewables.com/Home.aspx	Consent granted in March 2014. Delivery expected early 2020s.	950
Wind	Inch Cape	SDIC http://www.inchcapewind.com	New application submitted August 2018.	784
Wind	Kincardine	Atkins / Pilot Offshore Renewables http://pilot-renewables.com/	Consent received 2017. Currently under construction	49.6
Wind	Dounreay Tri Demonstration Project	Hexicon https://www.hexicon.eu/dounreay-tri/	Currently on hold, delivery expected 2020 (company in administration)	10
Wind	Firth of Forth 2	SSE Renewables / Fluor http://www.seagreenwindenergy.com	In planning	1800
Wind	Firth of Forth 3	SSE Renewables / Fluor http://www.seagreenwindenergy.com	In planning	800
Wind	Moray Firth Western Development Area	EDPR http://www.morayoffshorerenewables.com/Home.aspx	In planning	750

Energy Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Wind	Forthwind OWF, Methil	Forthwind Ltd	Consented, variation to consent submitted in October 2018	18
Wind Total				**7636.6**
Tidal Stream	North Yell, Bluemull Sound, Shetland	Nova Innovation (http://www.novainnovation.co.uk/index.php/north-yell)	Fully operational since 2017. Expansion to 0.6 MW planned.	0.3
Tidal Stream	Sound of Islay	Scottish Power Renewables (http://www.scottishpowerrenewables.com/pages/sound_of_islay.asp)	Consent granted in March 2011. Pre-construction. (not currently active as a project)	10
Tidal Stream	Ness of Duncansby, Pentland Firth	Scottish Power Renewables (http://www.scottishpowerrenewables.com/pages/ness_of_duncansby.asp)	In early stages of planning. Agreement to lease secured.	95
Tidal Stream	Westray South, Pentland Firth	DP Energy (http://www.dpenergy.com/projects/tidal/westray-south)	In development. Agreement to lease secured. Scoping Report submitted November 2011.	200
Tidal Stream	Brough Ness, Pentland Firth	Simec Atlantis Energy (https://simecatlantis.com/projects/brough-ness/)	In development.	100
Tidal Stream	Inner Sound, Pentland Firth	Simec Atlantis Energy (https://simecatlantis.com/projects/meygen/)	Phase 1 (6 MW) in operation.	398
Tidal Stream	Mull of Kintyre, Argyll	Argyll Tidal Ltd (http://www.gov.scot/Topics/marine/Licensing/marine/scoping/ArgyllTidalArray)	Consent granted in May 2014 for one demonstration turbine (0.5MW) to be installed. Pre-construction.	0.5
Tidal Stream	Isle of Islay, Islay	DP Marine Energy Ltd (http://www.dpenergy.com/projects)	In development. Agreement to lease secured. Consent received 2017.	30
Tidal Stream	Lashy Sound	Scotrenewables Tidal Power Limited (SRTP) (http://www.gov.scot/Resource/0045/00456955.pdf)	In development. Agreement to lease secured. Scoping Report submitted in July 2014.	10

Energy Type	Name/ Location	Company (Project Website)	Status	Capacity (MW)
Tidal Stream	Brims Tidal Array (formerly Cantick Head)	SSE Renewables and OpenHydro Group Ltd (http://sse.com/whatwedo/ourprojectsandassets/renewables/brims)	In development. Agreement to lease secured. EIA submitted 2016 (company in administration)	200
Tidal Stream	Mull of Galloway	Marine Current Turbines (https://simecatlantis.com/projects/galloway/)	In planning. Agreement to lease secured.	30
Tidal Stream	Fall of Warness	European Marine Energy Centre Ltd	Test site.	N/A
Tidal Stream	Shapinsay Sound	European Marine Energy Centre Ltd	Test site.	N/A
Tidal Stream	Islay Demonstration Zone	European Marine Energy Centre Ltd	Test site.	N/A
Tidal Stream	Stronsay Firth	European Marine Energy Centre Ltd	Test site.	N/A
Tidal Total				**1,073**
Wave	Billia Croo	European Marine Energy Centre Ltd	Test site	N/A
Wave	Scapa Flow	European Marine Energy Centre Ltd		N/A
Wave	Scottish Sea Farms (MANTA) - Teisti Geo	Scottish Sea Farms	Marine Licence Granted May 2018 (Operational)	0.262
Wave	WaveNet Mingary	Wavenet Energy Mingary Ltd.	Marine Licence issued – operational	0.45
Wave	Harris Demonstration Zone	European Marine Energy Centre Ltd	Test site	N/A
Wave Total				**0.712**
Hybrid	Katanes Floating Energy Park	Katanes Floating Energy Ltd	Screening opinion issued November 2017	11.6
Hybrid Total				**11.6**

Current economic value and employment

The offshore wind industry supported approximately 30,000 full-time equivalent (FTE) direct, indirect and induced jobs in 2017 across the UK[89]. However, this figure is not broken down to allow assessment of the sector's importance for Scotland. In 2013, a survey found that the UK offshore wind and marine energy sector directly employed 18,465 full-time equivalent (FTE) jobs (approximately 37% in offshore wind and 9% in marine) and had a turnover of £8.1 billion[90]. Another comprehensive study by Scottish Renewables showed that during 2013 the renewables industry in Scotland was the largest employer by generation type in Scotland. The industry supported 11,695 FTE jobs, with 1,842 of those in offshore wind energy and 805 in the wave and tidal energy sector. Similarly, the Department for Business, Innovation and Skills[91] reported 2,100 and 1,000 jobs were associated with the offshore wind and marine (wave and tidal) energy sectors respectively in Scotland in 2013. This compares with a total for the energy sector as a whole (including water supply) of 42,000 people in 2008[92]). Although this latter figure represents 1.7% of total employee jobs in Scotland, it does not include those people who work in the supply chain, thus the actual figure could be larger[93]. Given the share of electricity generated by renewables, it is likely that employment related to renewable energy is also larger than the figure quoted, since this only relates to direct employment, and therefore does not consider indirect or induced jobs.

Supply chain for offshore renewables

The supply chain for offshore renewables covers all the jobs associated with manufacturing, transporting and installing renewable devices, as well as related tasks such as maintenance, surveying, and operations.

Predictions of significant increases in employment linked, in particular, to the offshore wind industry, are likely to be revised downwards considerably, as the majority of these roles are linked to the extent to which components are manufactured in Scotland. Currently, a large proportion of the materials and components for offshore windfarms are outsourced from China and mainland Europe and thus associated employment is focused outside the UK[94].

A report undertaken on the economic benefits of offshore wind energy in the East and North East regions of Scotland notes the potential for the offshore wind industry to create more than 4,100 FTE jobs, and a GVA impact of £1.6bn in Scotland based on

[89] Cambridge Economics (2017), Future UK Employment in the Offshore Wind Industry, A report commissioned by the University of Hull on behalf of Aura, June 2017.

[90] RenewableUK. 2013. Working for a Green Britain & Northern Ireland 2013–23. Employment in the UK Wind & Marine Energy Industries. September 2013.

[91] Department for Business, Innovation and Skills. 2015. The size and performance of the UK low carbon economy. Report for 2010 to 2013. March 2015.

[92] Scottish Government, 2010. Energy in Scotland: A Compendium of Scottish Energy Statistics and Information, Report produced December 2010.

[93] ibid

[94] ch2m. 2016. Scenario Mapping: The economic benefits of offshore wind energy in the East and North East regions of Scotland. Report to Marine Scotland, East Coast Renewables and The Crown Estate, April 2016.

the development of 1.5 GW of capacity by 2022. The main strengths of the supply chain in Scotland are listed as[95]:

- Offshore engineering with expertise in construction, operations and maintenance, project management and training (due to the offshore Oil and Gas sector);
- Design and development services including consultancy, engineering and project development services;
- Research and development expertise in the private sector, academia and public sector funded programmes;
- Existing port facilities with North Sea access and surrounding offshore service networks; and
- Fabrication and manufacturing of components.

Similarly, a report prepared by BVG Associates for the Department for Business, Innovation and Skills[96] on the capabilities and opportunities of the UK offshore wind supply chain reviewed the following six key areas:

- Project management and development - internal engineering studies and project management work, managing external contracts for engineering studies, planning applications, environmental impact assessments (EIAs), site investigations, environmental services and construction contract management activities;
- Turbine supply - manufacture, assembly and system-level functional test of all electrical and mechanical components and systems that make up a wind turbine (e.g. nacelle, rotor and the tower);
- Balance of plant supply - all aspects of the supply of cables, turbine foundations and offshore/onshore substations;
- Installation and commissioning - transport of completed assemblies from manufacturing facilities, installation port facilities, foundation installation, turbine installation and commissioning, array/export cable installation, offshore substation installation and sea-based support;
- Operation, maintenance and service (OMS) - Operational costs relating to the day-to-day control of the wind farm (including minor spares and consumables), maintenance activities that are undertaken using the wind farm's normal staff and equipment and, where required, minor/major servicing; and
- Support services - Research, development and demonstration (RD&D), training, enabling activities, supply of health and safety services equipment and tooling, consumables and materials.

[95] ch2m. 2016. Scenario Mapping: The economic benefits of offshore wind energy in the East and North East regions of Scotland. Report to Marine Scotland, East Coast Renewables and The Crown Estate, April 2016.

[96] BVG Associates. 2018. Scottish offshore wind supply chain: Gap Analysis Refresh. A report prepared by BVG Associates for the Department for Business, Innovation and Skills. September 2014.

In summary, the report concludes that there are opportunities for the supply chain in Scotland, particularly in operations and maintenance. Opportunities in manufacture, however, are limited in by the limited size of the market and significant competition internationally where investment in manufacturing and assembly in Europe is likely to hamper opportunities.

Stage 1 of the National Renewables Infrastructure Plan (NRIP) identified a list of sites which could be developed to support offshore wind. These included[97]:

- Leith – integrated manufacturing;
- Dundee – distributed manufacturing and operation/maintenance;
- Nigg (note that this site has already been used to support the Beatrice Demonstration Project) – integrated manufacturing;
- Energy Park Fife at Methil (some supply chain investment has already occurred here) – further manufacturing;
- Aberdeen – distributed manufacturing and operation/maintenance;
- Hunterston – integrated manufacturing;
- Arnish – distributed manufacturing;
- Campbeltown/Machrihanish (some supply chain investment has already occurred here) – further manufacturing and operation/maintenance;
- Ardersier – integrated manufacturing;
- Peterhead – distributed manufacturing and operation/maintenance; and
- Kishorn – distributed manufacturing.

For the wave and tidal supply chain, site owners at Scrabster and Lyness in Scapa Flow are developing investment proposals so that there is support at these sites for companies awarded leases by The Crown Estate[98].

Future trends

Electricity Generation

The way Scotland generates and uses energy is changing rapidly and will continue to change over the coming decades. Key factors influencing change in Scotland include:

- The need to reduce greenhouse gas emissions from energy generation to tackle climate change;
- The increasing demand for low carbon electricity for transport;
- The continuing drive for energy efficiency to ensure that we use resources efficiently;
- Ensuring security of energy supplies in an uncertain geopolitical context; and
- Tackling energy poverty and ensuring that energy is affordable;

[97] Highland and Islands Enterprise (2010). National Renewables Infrastructure Plan Stage 2.

[98] Highland and Islands Enterprise (2010). National Renewables Infrastructure Plan Stage 2.

- An increasing focus on local energy systems, particularly to provide clean energy for Scotland, including island communities.

Scotland is committed to increasing the proportion of energy demand met by renewables as a key response to these drivers. As a nation with an abundance of renewable energy resources, the opportunity exists not only to meet domestic needs but also to export low carbon energy. The adoption of renewable energy technologies therefore also presents a significant economic opportunity for Scotland, including significant opportunity to lead on deep water offshore wind technologies.

Based on scenario modelling undertaken by National Grid[99], peak UK electricity demand is expected to rise from around 62 GW in 2016 to between 65-85 GW by 2050. This includes a forecast requirement for UK offshore wind capacity of between 8-18 GW by 2025 and 16-30 GW by 2050 (equivalent to around 50-100 TWh). Separately, the Energy Technologies Institute estimates that UK offshore wind deployment could reach 20-55 GW by 2050[100].

For Scotland, the National Grid scenarios suggest a total Scottish generating capacity of between 15 and 25 GW by 2035 (10-20 GW low carbon generation)[101]. With demand in Scotland not expected to exceed 4.7 GW by 2035 (which is much less than the Scottish generation capacity), there is potential for export of power south, out of Scotland into England, for a significant amount of time.

Based on the offshore wind, wave and tidal developments currently in planning, there is likely to be a significant increase in installed capacity in the period up to and beyond 2020 with potentially up to 7.6 GW of offshore wind capacity and 1.1 GW of tidal energy capacity (see Table A9 above).

Scotland's National Marine Plan[102] identifies a number of draft plan option areas for future development of offshore wind, wave and tidal energy projects, within which lease options may be offered in the future (Figure A13). A further Sectoral Marine Plan for Offshore Wind is currently in preparation, which will identify areas of Scottish Waters which are considered to be appropriate for offshore wind development in the future[103]. These options will supersede the draft plan option areas in the Marine Plan.

A.6.3 Assumptions on Future Activity

It is assumed that coastal power stations will be decommissioned in accordance with current decommissioning timetables which are currently projected as 2023 for Hunterston B and 2030 for Torness, with no date currently available for Peterhead. It is assumed that no new coastal power stations are built that interact with possible MPAs.

[99] National Grid, 2018. Future Energy Scenarios. Available at http://fes.nationalgrid.com/

[100] Energy Technologies Institute, 2015. UK scenarios for a low carbon energy system transition. Available at http://www.eti.co.uk/insights/options-choices-actions-uk-scenarios-for-a-low-carbon-energy-system

[101] National Grid, 2017. Electricity Ten Year Statement. Available at https://www.nationalgrid.com/uk/publications/electricity-ten-year-statement-etys

[102] Marine Scotland, 2014. Scotland's National Marine Plan. The Scottish Government, Edinburgh 2014.

[103] Marine Scotland (2018) Sectoral Marine Plan for Offshore Wind Energy (encompassing Deep Water Plan Options) - Context Report, May 2018.

For offshore renewables, the following assumptions are made:

- The three sites (Beatrice, Inch Cape and Neart na Gaoithe) identified in the current Plan for Offshore Wind in Scottish Territorial Waters (Scottish Government, 2011b) that are being progressed will be built in line with current capacity and programme estimates;
- The two R3 OWF sites (Firth of Forth and Moray) will be built in line with current capacity and programme estimates, subject to any constraints associated with existing Natura 2000 sites;
- Wave and tidal sites with existing 'agreements for lease' will be developed in line with current capacity and programme estimates; and
- While Marine Scotland has identified several Option Areas for future offshore wave and tidal development, there are no extant proposals for development in these areas. It has therefore not been possible to quantify potential impacts on possible future development within these areas.
- Marine Scotland is currently taking forward development of a new plan for offshore wind and recently consulted on 24 initial Areas of Search (AoS). Further work and analysis on the areas to take forward for assessment is underway and a new draft plan is anticipated to be consulted on in summer 2019. One of the AoS has a small area of overlap with the SOH pMPA, whilst further AoS are in proximity to, or would potentially require export cables through, the pMPAs. There is uncertainty regarding the likelihood of development in any individual AoS, and AoS may be modified following consultation.

A.6.4 Potential Interactions with pMPA Features

The planning, construction, operation and decommissioning of offshore renewables development has the potential to affect pMPA features through a number of impact pathways. In particular, the construction of infrastructure on the seabed may directly or indirectly change existing seabed substrates and/or lead to smothering of sensitive habitats as a result of sediment plumes. Significant levels of underwater noise may be generated during construction, depending on the methodologies used. This may pose significant risks to hearing-sensitive species, particularly fish. The presence of structures above and below sea level may pose a collision risk to mobile species (e.g. fish and marine mammals). The transmission of electricity through seabed cables during the operational phase has the potential to introduce electromagnetic fields into the marine environment with the potential to affect electro- and magneto-sensitive species. The construction, operation and maintenance of offshore renewable energy devices may cause visual or noise disturbance to fish and marine mammals.

A.6.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland for assessment (see Appendix D: Management Scenarios):

- Additional assessment of the impact of the development proposal on pMPA features to support marine licence determination;
- Current best practice used to minimise impacts on burrowed mud and sandeel habitat;
- Exclude development which could create a barrier to species movement in Shark Awareness Zones (SOH);
- Produce vessel management plans as required by licensing;
- Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October (SOH);
- Follow existing best practice and licensing process for installation of new cables by minimising disturbance to sandeel habitat (SOH, NEL), burrowed mud (STR);
- No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR); and
- No noisy activities during Risso's dolphin high season (May – October) (NEL).

No measures are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

A.6.6 Assessment Methods

Additional assessment to support marine licence application

There are no proposed developments within the pMPAs, or which are likely to require export cables through a pMPA. Therefore, there are not expected to be any applications which would require additional assessment.

It is noted that the development of regions within the Offshore Wind AoS has the potential to require export cables to transect MPAs, but there is considerable uncertainty as to the likelihood of development and therefore insufficient evidence upon which to base an assessment of cost.

Current best practice used to minimise impacts on burrowed mud and sandeel habitat

The Energy industry will already follow best practice as part of the licensing process, and therefore there is no additional cost associated with this management measure.

Exclude development which could create a barrier to species movement in Shark Awareness Zones (SOH)

There is no development proposed in the Shark Awareness Zones. There is one area identified as a Draft Plan Option (DPO) for wave energy to the west of Tiree within the shark awareness zone, therefore development within this area is likely to be excluded. This is a loss of 2 % of the total DPOs for wave energy, and although there is an associated opportunity cost this is assumed to be negligible.

Produce vessel management plans as required by licensing

There are no proposed new developments within the pMPAs, or which are likely to require export cables through a pMPA. Therefore, there are not expected to be any new applications which would require the development of vessel management plans.

It is noted that the development the Offshore Wind AoS has the potential to require export cables to transect MPAs, but there is considerable uncertainty as to the likelihood of development in areas yet to be identified under the sectoral marine plan process while the draft offshore wind plan is being progressed and therefore insufficient evidence upon which to base an assessment of cost.

Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October (SOH)

There are currently no proposals for development within the Shark Awareness Zones or requiring transit through Shark Awareness Zones. It is therefore assumed that there will be no additional cost from this management measure to the Energy industry.

Follow existing best practice and licensing process for installation of new cables by minimising disturbance to sandeel habitat (SOH, NEL), burrowed mud (STR)

The Energy sector will already follow best practice as part of the licensing process, and therefore there is no additional cost associated with this management measure.

No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR)

There is one current renewable infrastructure development within the pMPA sites, the export cable route for the Moray East windfarm. This is currently entering the construction phase, and therefore pre-consenting surveys have been completed, however there is potential for the seasonal restriction to impact post-construction operational and monitoring surveying. It has been assumed that a single survey would be required annually to check the condition of the cabling. This survey, specifically the approximately 12 nm of cable within STR, is assumed to take 3 days of survey time to cover three transect lines

This survey activity within the STR pMPA will be required to be undertaken November – March, and there is increased likelihood of weather downtime during this period. To assess any impact of increased downtime it has been assumed that this will double the time taken to undertake the survey. As such 3 days of survey time, which would take 4 days in summer (with 1 day of weather downtime) will take 8 days in winter (with 5 days of weather downtime). The additional downtime for a 3 day survey due to the temporal restrictions is therefore 4 additional days.

There is a small area of overlap between one of the Areas of Search (AoS) for offshore wind, however given the small overlap, the unknown likelihood of development, and the likelihood of changes to the AoS as they are progressed in the development of the sectoral marine plan for offshore wind, any impact related to this is unquantifiable.

There are currently no known planned new applications for cables likely to require survey. There is potential for applications regarding export cables for offshore wind

related to development under the future offshore wind plan, currently in preparation. However, the high level of uncertainty regarding the likely extent of development means that impacts on these applications are currently unquantifiable.

It has been assumed that downtime costs are £10,000 per day at 2019 prices.

No noisy activities during Risso's dolphin high season (May – October) (NEL)

There is high uncertainty regarding the potential for the development of offshore wind, and hence the likelihood of export cables transecting NEL pMPA. It is not therefore possible to quantify the cost associated with seasonal restrictions on surveying these cables.

Cost of uncertainty and delays

The designation of pMPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

A.6.7 Limitations

- Uncertainty concerning scale and location of future development for offshore renewables, particularly the location and scale of offshore wind, wave and tidal development within the Option Areas;
- All costs related to weather related downtime, are estimates only, as in reality conditions may be better or worse and costs will vary.

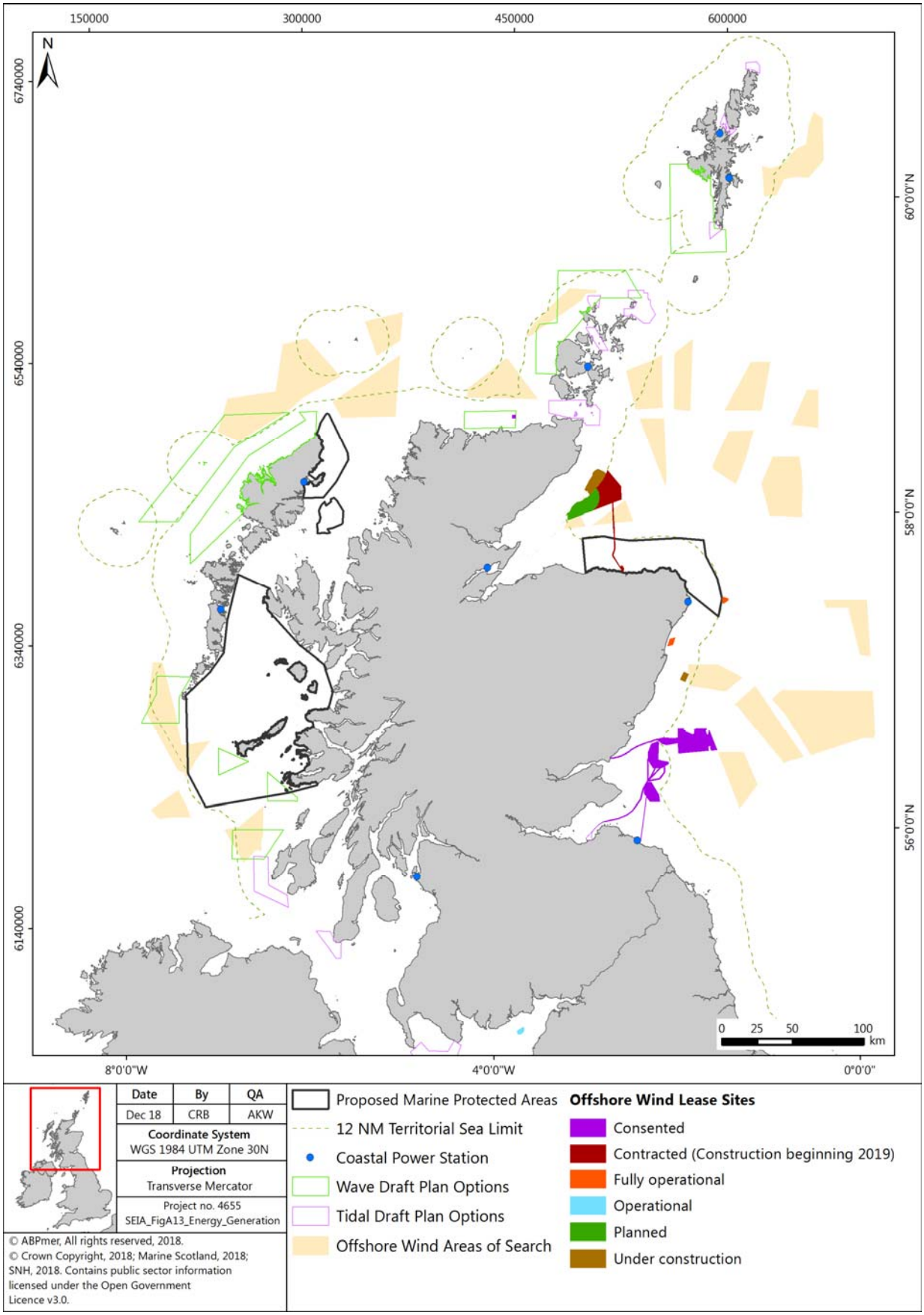


Figure A13 Energy generation infrastructure (current, planned and initial scoping areas subject to change) in Scottish waters

A.7 Military Activities

A.7.1 Sector Definition

The military defence sector makes use of the Scottish coastline for the location of bases and training and use of the sea for training, test and evaluation activities and the surveillance and monitoring of waters to detect and respond to potential threats. In this assessment, military interests comprise the use of the coast and seas by the Royal Navy (submarine bases, jetties and exercise areas), Army (training camps and firing ranges), Royal Air Force (bases, coastal Air Weapon Ranges and Danger Areas) and Ministry of Defence (MOD) (Defence Test and Evaluation Ranges to trial weapon systems)[104].

A.7.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A10.

Table A10 Military activities information sources

Scale	Information Available	Date	Source
Scotland	Scottish Naval Exercise Areas Information	2010	https://marinescotland.atkinsgeospatial.com/nmpi/default.aspx?layers=518
Scotland	Defence Analytical Services and Advice. DASA Quad Service. 4	2010	www.dasa.mod.uk/
Scotland	Military Employment by Region	2017	MOD, 2017 Quarterly Location Statistics
UK	Military Practice Areas	Current	Oceanwise / UKHO
UK	Military low flying zones	2014	UK Military Airfields Guide
UK	Munitions Disposal Sites (Chemical, Radioactive, Disused)	1945–1956 (Radioactive – no dates)	https://marinescotland.atkinsgeospatial.com/nmpi/
UK	MOD Regional Expenditure with UK Industry and Commerce and Supported Employment	2013–2018	UK Defence Statistics, MOD
UK	Military ports owned by MOD	2010	CP2

Location and intensity of activity

Scottish Waters (including territorial waters and the Exclusive Economic Zone) are extensively used in direct support of UK defence. Military activities occur in both inshore and offshore waters around the Scottish coast. All coastal military locations and the full

[104] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

area available for military training and other defence activities are shown in Figure A14. MOD strategic interests relevant to the scoping area are to:

- Retain the capability to store, maintain and deploy the deterrent;
- Free navigation for surface and subsurface naval vessels for national defence;
- Safeguarding of navigational routes and nationally critical infrastructure;
- Safeguard the usage of designated Danger Areas and Exercise Areas for military training and defence test & evaluation purposes; and
- Retain strategic maritime infrastructure, installations and coastal MOD facilities.

Activities relating to maritime transport are mainly associated with naval bases and the only naval base in Scotland is Her Majesty's Naval Base (HMNB) Clyde at Faslane. Sea training is carried out within defined military practice and exercise (PEXA) training areas. Although the PEXA cover large areas of sea, military exercises cover only a proportion of these areas at any one time and are restricted temporally to a number of weeks per year.

Two major NATO training exercises (Joint Warrior exercises) also take place each year, typically in April and October. The training exercise stretches from the Irish Sea, north to Cape Wrath and east to the Moray Firth.

Military aviation may also occur over coastal and marine areas. The UK has a military low flying system which supports training below 2000 feet. The UK is divided into 20 separate low flying areas (LFAs), including two large areas in Scotland (Area 14 covering mainland Scotland north of the Central Region, the Western Isles, Orkney and Shetland; and Area 16 which includes the Borders region of Southern Scotland, Dumfries and Galloway and other counties up to and including those within the central belt). The LFAs in Scotland include two Tactical Training Areas (TTAs) in northern Scotland and the borders area of southern Scotland and northern England where at specific times each day aircraft can fly as low as 100 feet. In addition there are air weapons ranges, which are used for low flying military aircraft and air to ground bombing, at Tain in Ross-shire and Cape Wrath in Sutherland.

Economic value and employment

Defence activities do not generate a tangible output and therefore cannot be valued. However, information is available on the expenditure within relevant departments, e.g. the Commander-in-Chief (C-in-C) Navy Command which is responsible for the operation, resourcing and personnel training of ships, submarines and aircraft[105].

The MOD employs people throughout the UK in support of its operations in the marine environment, including HM naval bases, MOD ranges and coastal estates. Gross Value Added (GVA) of UK military activity in the sea was estimated to be approximately

[105] United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra.gov.uk/

£400 million in 2012[106]. Marine activities and hence the location of the value to the economy are mainly related to the location of the naval bases and exercise areas.

In 2016/17, the UK military defence expenditure in Scotland was £1,592 million, supporting 10,500 jobs in Scottish Industry, with an increasing trend from 2013/14 onwards[107].

In terms of direct employment, at October 2017, there were 9,970 military (armed forces) personnel and 3,970 civilian personnel based in Scotland. The armed forces comprised 4,050 Navy, 4,190 Army and 1,730 RAF personnel[108].

Future trends

Specific defence projects may provide significant employment opportunities. For example, with respect to future aircraft carriers, building the hull sections and outfitting the vessels has provided work for about 10,000 people, including 3,500 at the two Clyde yards and 1,600 at Rosyth, Fife at the project's peak[109]. Further investment is planned for Scottish military bases, including a significant investment programme to prepare the HM Naval Base Clyde's waterfront for the Dreadnought class submarines.

Owing to the confidential nature of military defence activities it is difficult to assess likely future trends, however future employment will be governed by spending priorities within the MOD.

A.7.3 Assumptions on Future Activity

In the absence of information on future activity levels, it is assumed current locations and levels of usage will continue throughout the period of the assessment.

A.7.4 Potential Interactions with pMPA Features

Many of the activities of the MOD have the potential to interact with pMPA features. Underwater noise associated with SONAR use and military weapons trials may impact fish and marine mammals. There is also wider potential for visual and noise disturbance to these features during exercises. Weapons trials may cause surface and sub-surface abrasion to the seabed habitat and species, in some cases resulting in a direct loss of habitat. Associated synthetic pollutants may also enter the water column. Of lesser

[106] Marine Science Co-ordination Committee (2015) Economic value and employment in the UK of activities carried out in the marine environment.

[107] MOD, (2017). MOD Expenditure with UK Industry in Current Prices: Breakdown by Region.

[108] MOD, 20175. Quarterly Location Statistics (QLS) 1 October 2017. Available online: https://www.gov.uk/government/statistics/location-of-uk-regular-service-and-civilian-personnel-quarterly-statistics-2017

[109] United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra.gov.uk/

concern is the death or injury of mobile species by collision with military vessels, and the possible introduction or translocation of invasive non-native species[110].

Despite the potential for such interactions with features proposed for designation, the infrequency of military activities and existing MOD procedures should ensure that environmental impacts are minimised.

A.7.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Revision of Marine Environment and Sustainability Assessment Tool (MESAT) (and other MoD environmental tools) and additions to electronic charting by the Hydrographic Office; and
- Subsequent compliance with MESAT revisions
- Vehicle speeds restricted to <6 knots within the Shark Awareness Zones between June and October (SOH);
- Follow existing best practice mitigation measures / guidance to minimise impacts of noisy activities;
- No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR); and
- No noisy activities during Risso's dolphin high season (May – October) (NEL).

No measures are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

A.7.6 Assessment Methods

<u>Vehicle speeds restricted to <6 knots within the Shark Awareness Zones between June and October (SOH);</u>

MOD activities are reserved. MOD has its own best practice guidelines for meeting obligations. The impact of this management measure cannot therefore be quantified.

<u>Follow existing best practice mitigation measures / guidance to minimise impacts of noisy activities</u>

Best practice will already be followed by the MOD, therefore there is not considered to be any additional cost associated with this management measure.

[110] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR)

The level of noisy activity undertaken by the MOD is unknown. In addition, MOD activities are reserved. MOD has its own best practice guidelines for meeting obligations. The cost associated with this management measure cannot therefore be quantified.

No noisy activities during Risso's dolphin high season (May – October) (NEL)

The level of noisy activity undertaken by the MOD is unknown. In addition, MOD activities are reserved. MOD has its own best practice guidelines for meeting obligations. The cost associated with this management measure cannot therefore be quantified.

Revisions to MESAT

The costs to MoD have been assessed at a national level. It has been assumed that the following costs are incurred:

- Initial revision of MESAT (and other MoD environmental tools) and additions to electronic charting by the Hydrographic Office are estimated to cost £28,000 (at 2019 prices) based on an estimate of £25k at 2012 prices[111]. This cost would be incurred in 2020; and
- Additional annual maintenance costs are estimated to be £5,600 (at 2019 prices) based on an estimate of £5k at 2012 prices[112]. This cost would be incurred annually from 2021.

Compliance with MESAT revisions

As MoD is operational throughout Scottish waters and as MPAs are likely to be extensive and have varied management measures, it has been assumed that consideration of MPAs will be undertaken as part of planning for all MoD maritime activities. It has been estimated that the costs to MoD will be £11,100 per year in the first four years of the IA period, reducing to £5,600 p.a. from year 5 onwards (at 2019 prices)[113].

A.7.7 Limitations

- Uncertainty concerning the location and scale of current or future activity.

[111] 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

[112] ibid

[113] 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

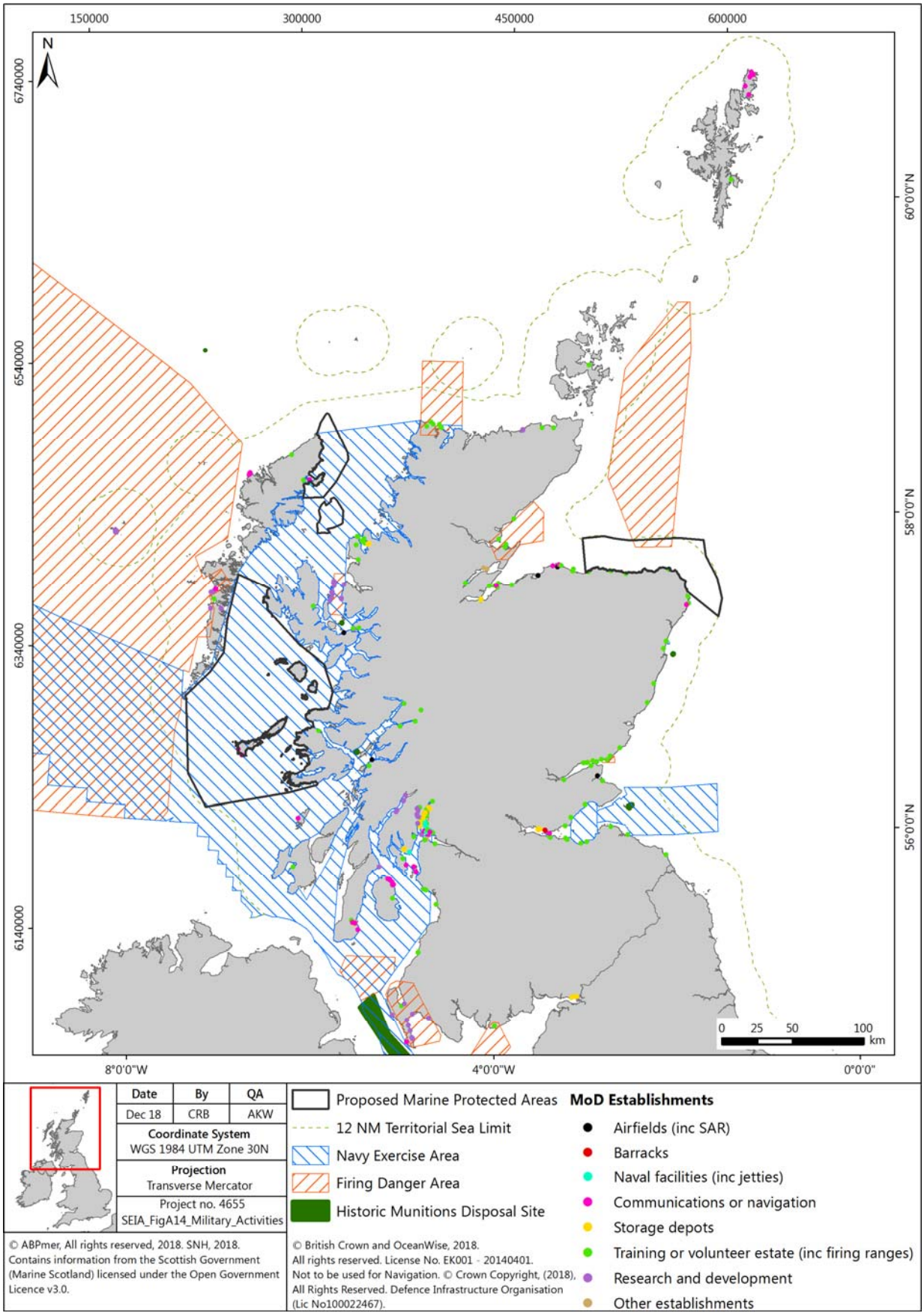


Figure A14 Military assets and practice areas in Scottish waters

A.8 Oil and Gas

A.8.1 Sector Definition

This sector relates to the extraction of oil and gas in the sub-sea environment largely from offshore reserves. Oil reserves include both oil and the liquids and liquefied products obtained from gas fields, gas-condensate fields and from the associated gas in oil fields. Gas reserves are the quantity of gas expected to be available for sale from dry gas fields, gas-condensate fields and oil fields with associated gas. For this assessment, activity within this sector includes exploration, production, interconnectors and gas storage (i.e. the 'upstream' oil and gas sector).

A.8.2 Overview of Existing Activity

Information sources used in the assessment are listed in Table A11.

Table A11 Oil and gas information sources

Scale	Information Available	Date	Source
Scotland	Revenues and production from Scottish sea areas (2015-2018). Oil, gas and NGL production and revenue (2015-2018) for all Scottish waters and regional breakdown	2015-2018	Scottish Government[114,115]
Scotland	Platforms, existing pipelines and wells interactive maps	Current	National Marine Plan interactive (NMPi)
UK	Offshore licence areas around the UK, all blocks/rounds data, hydrocarbon fields, significant discoveries and wells Presented through multiple interactive maps	Current	Oil & Gas Authority (OGA)
UK	Decommissioning of offshore installations and pipelines	Current	Department for Business, Energy and Industrial Strategy (BEIS)[116]
UK	Annual economic, workforce and decommissioning reports	2018	Oil and Gas UK[117,118,119]
UK	Digest of UK Energy Statistics	2018	BEIS[120]

[114]Scottish Government, 2018a. Oil and Gas Production Statistics [online] Available at: https://www.gov.scot/Resource/0054/00540203.pdf

[115] Scottish Government 2018b. Energy in Scotland 2018 [online] Available at: https://gov.scot/Resource/0053/00531701.pdf

[116] BEIS, 2018a. Oil and gas: decommissioning of offshore installations and pipelines [online] Available from: https://www.gov.uk/guidance/oil-and-gas-decommissioning-of-offshore-installations-and-pipelines

[117] Oil and Gas UK. 2018a. Economic Report 2018. Available at: https://oilandgasuk.cld.bz/Economic-Report-2018

[118] Oil and Gas UK. 2018b. Workforce Report 2018. Available at: https://oilandgasuk.cld.bz/Workforce-Report-2018

[119] Oil and Gas UK. 2018c. Business Outlook 2018. Available at: cld.bz/c41vNPt/2/

[120] BEIS, 2018b. Digest of United Kingdom energy statistics 2018. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/736148/DUKES_2018.pdf

Location and intensity of activity

There is extensive infrastructure associated with oil and gas developments in Scottish waters, including seabed and platform mounted production facilities and networks of pipelines bringing oil and gas ashore for processing[121] (Figure A16). It is estimated that there is approximately 12,800 km of oil and gas pipeline in Scottish waters with the majority of pipelines outwith the 12nm limit (i.e. offshore). Virtually all hydrocarbon fields, platforms, pipelines and infrastructure occur within the central and northern North Sea and to the West of Shetland. The North Sea fields are generally mature, but there is the potential for significant new development to occur West of Shetland, particularly associated with the Laggan-Tormore fields. Total has made a large gas discovery at Glendronach field which is estimated to have a capacity of around one trillion cubic feet of gas. It could be developed quickly and at a low cost by tying the field to existing infrastructure at the Edradour field nearby[122].

Information on the production of oil, natural gas liquids (NGL) and gas from Scottish Sea areas between 2014 and 2018 are provided by The Scottish Government[123] and are shown in Table A12. Scottish and UK oil and gas production has declined rapidly between the turn of the century and 2013. Production levelled off during 2014 and then increased significantly during 2015, following several years of substantial investment in the development of new and existing fields. Since 2015, total oil and gas production has been relatively stable.

Table A12 Annual oil and gas production and revenues from Scotland[124] and the percentage change from previous year (Scottish Government, 2018)

Production (millions of tonnes of oil equivalent)	**2014**	**2015**	**2016**	**2017**
Crude oil	38.6 *(-2.3%)*	44.7 *(+15.7 %)*	45.9 *(+2.8%)*	45.1 *(-1.8%)*
NGL	2.4 *(+13%)*	2.5 *(+6.7%)*	3.3 *(+31.9%)*	3.7 *(+9.4%)*
Natural Gas	19.0 *(+4.8%)*	22.5 *(+18.5%)*	26.0 *(+15.6%)*	24.9 *(-4.2)*
Total	60.0 *(-1.6%)*	69.7 *(+15.1%)*	75.3 *(+4.4%)*	73.7 *(-1.1%)*
Revenue (£m)	**2014**	**2015**	**2016**	**2017**
Crude oil and NGL	16,979 *(-14.8%)*	12,384 *(-27.1%)*	11,787 *(-4.8%)*	14,923 *(+26.6%)*
Natural Gas	3,346 *(-15.4%)*	4,061 *(+21.4%)*	3,505 *(-13.7%)*	3,901 *(+11.3%)*
Total	20,326 *(-14.9%)*	16,445 *(-19.1%)*	15,293 *(-7%)*	18,824 *(+23.1%)*

[121] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[122] Talal Husseini. 2018. Total makes major offshore UK gas discovery in West of Shetland. Available at https://www.offshore-technology.com/news/total-uk-gas-discovery/. Accessed 16/10/2018.

[123] Scottish Government, 2018a. Oil and Gas Production Statistics [online] Available at: https://www.gov.scot/Resource/0054/00540203.pdf

[124] Scotland includes Scottish Adjacent Waters

* mtoe = million tonnes of oil equivalent.

The 2018 Oil and Gas UK Economic Report[125] provides a current indication of oil and gas production in the UK. The report summarises industry performance up to August 2018. It highlights the re-stabilisation of the sector after the recent downturn in the oil price, with more investment in the sector in the first eight months of 2018, than the entirety of 2016 and 2017. Decommissioning activities are now a significant activity with over £1 billion spent annually since 2013 and nearly £2 billion spent in 2017. Production efficiency has increased barrels of oil equivalent per day (boepd) by 16% from 2014-2017, with an approximate 1.7 million boepd in the first half of 2018.

A.8.3 Economic value and employment

The oil and gas industry is the principal source of fuel and power for Scotland, meeting approximately 90% of the primary energy need in Scotland in 2015[126]. Information on the total revenue from oil, NGL and gas is provided in Table A12. The total revenue from oil, NGL and gas progressively decreased between 2014 and 2016 before increasing in 2017. It was estimated that the oil and gas industry was worth £9.2 billion to the Scottish economy in 2016[127] with a GVA of £1.6 billion[128]. However, the Scottish oil and gas sector has recently experienced a significant decline in production revenue and previous years have been more lucrative. Brent prices of crude oil collapsed in the second half of 2014; prices fell from $110 per barrel (bbl) in mid-year to $55/bbl at the end of December 2014 and even traded below $40/bbl in 2016. It has been progressively increasing since early 2016, and the average in 2017 was $54/bbl and the first half of 2018 trading at $70/bbl. This increase in barrel price has increased the total revenue of the Scottish sector in 2017 even with a slight decrease in production.

The industry is a still major employer even after a large cut in workforce due to the downturn in the sector in 2014. It is estimated that in 2018 the sector will increase the total jobs it supports for the first time since 2014. The oil and gas industry currently supports around 283,000 jobs across the UK, including 36,800 directly employed by oil and gas companies and major contractors, of which 19,700 are in Scotland[129]. Around 127,000 people are employed in the wider supply chain and 119,700 people are in jobs induced by the economic activities of employees. About 39% of the jobs supported by the sector are located in Scotland, not only in major cities such as Aberdeen but across the whole of Scotland including remote areas of the country[130].

[125] Oil and Gas UK. 2018a. Economic Report 2018. Available at: https://oilandgasuk.cld.bz/Economic-Report-2018

[126] Scottish Government, 2017. Scottish Energy Strategy: The future of energy in Scotland [online] Available at: https://www.gov.scot/Resource/0052/00529523.pdf

[127] Scottish Government 2018b. Energy in Scotland 2018 [online] Available at: https://gov.scot/Resource/0053/00531701.pdf

[128] Scottish Government. 2018c. Scotland's Marine Economic Statistics. Available at: https://www2.gov.scot/Topics/marine/Publications/TopicSheets/tslist/economy

[129] ibid

[130] Oil and Gas UK. 2018b. Workforce Report 2018. Available at: https://oilandgasuk.cld.bz/Workforce-Report-2018

Future trends

Scotland's Energy Strategy[131] has set the ambitious target of 50% of Scotland's energy consumption from renewable sources by 2030. In 2016, 54% of Scotland's electricity needs were met from renewables. This could potentially have a knock-on effect for the oil and gas industry with less demand for oil in Scotland, however, currently the majority of Scottish oil products are exported, and this demand is expected to increase[132].

The 2018 Market Outlook[133], suggests that there is unknown oil demand beyond 2020. An increase in demand up to then is predicted, but after 2020, different scenarios could see the demand increase, stabilise or reduce. Due to these unknown demands the future trends are harder to predict.

In the Scottish Government's Energy Strategy[134], two scenarios are hypothesised ("an electric future" and "a hydrogen future"), with both predicting a reduction in the amount of oil and natural gas needed within Scotland as a switch to more renewable forms of energy takes place. Under "an electric future", 40% of Scotland's energy flow would be from oil and natural gas, down from the 2015 baseline of nearly 90%. Under "a hydrogen future", just 18% of Scotland's energy flow would come from oil, and no natural gas would be used. There is no prediction made about the amount of export expected for the sector as a whole[135].

Up to the end of 2016, 43.5 billion barrels of oil equivalent (boe) had been recovered from the UK Continent Shelf (UKCS), with further proven and probable reserves of 5.7 billion boe and 7.4 billion boe respectively in discovered undeveloped resources[136]. This estimation does not take into account any new exploration success that could occur. At current rates of extraction this could sustain the industry for approximately 20 years, with no new investment, which is currently unlikely.

Figure A16 shows oil and gas production levels in recent years and OGA's current (March 2018) projections[137]. An annual 5% decrease in oil and gas production from 2018 to 2050 is projected under several scenarios. However the reduction in overall production is countered with a projected increase in gross revenues by exploiting new markets and increasing efficiency of capture[138].

[131] Scottish Government, 2017. Scottish Energy Strategy: The future of energy in Scotland [online] Available at: https://www.gov.scot/Resource/0052/00529523.pdf

[132] Oil and Gas UK. 2018a. Economic Report 2018. Available at: https://oilandgasuk.cld.bz/Economic-Report-2018

[133] Oil and Gas UK. 2018c. Business Outlook 2018. Available at: cld.bz/c41vNPt/2/

[134] Scottish Government, 2017. Scottish Energy Strategy: The future of energy in Scotland [online] Available at: https://www.gov.scot/Resource/0052/00529523.pdf

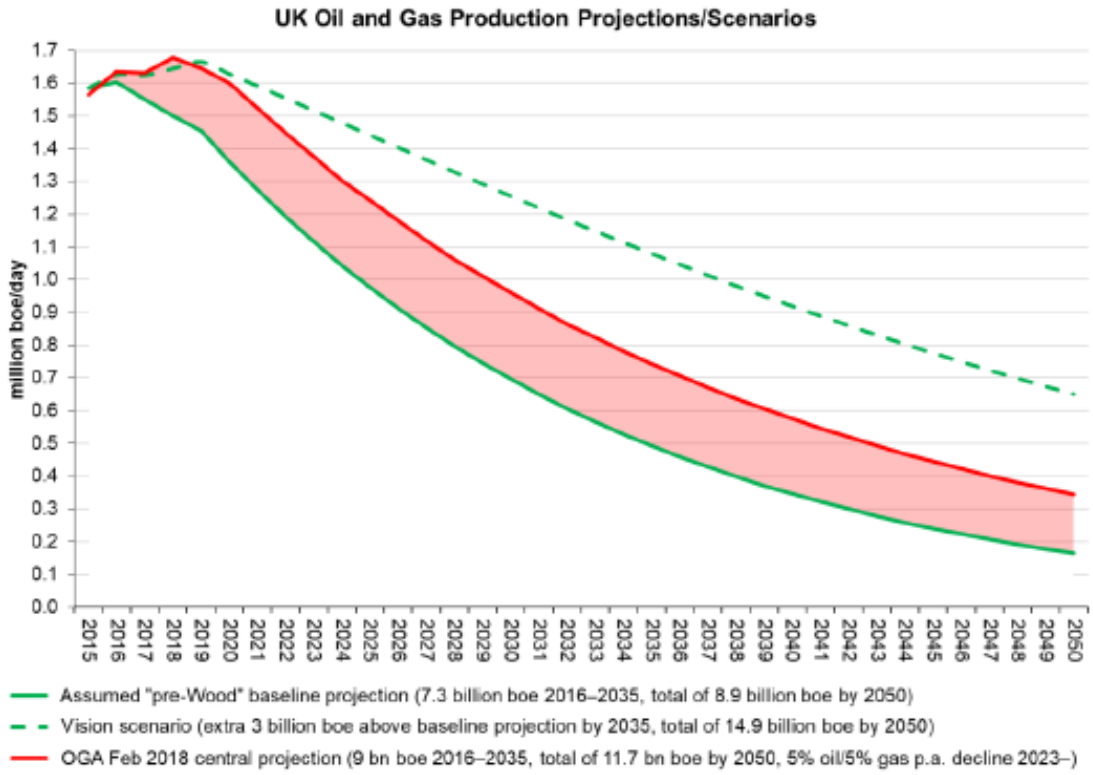
[135] ibid

[136] Oil and Gas Authority. 2017a. UK Oil and Gas Reserves and Resources - as at end 2016. Available at: https://www.ogauthority.co.uk/media/4425/uk-reserves-and-resources-v1.pdf

[137] Oil and Gas Authority. 2018. Projections of UK Oil and Gas Production and Expenditure. Available at: https://www.ogauthority.co.uk/media/4647/projections-of-uk-oil-and-gas-production-and-expenditure-march-2018.pdf

[138] Oil and Gas Authority. 2017b. Vision 2035. Available at: https://www.ogauthority.co.uk/media/3196/vision-2035-overview-january-2017.pdf

Figure A15 Actual and Projected UK Oil and Gas Production 1998-2019



Decommissioning is forecast to occur at 214 fields across the UKCS from 2017 to 2025, with 45 of these in Scottish waters[139]. The expanding decommissioning industry is estimated to be worth £17 billion between 2017 and 2025, with £1.7 billion to £2 billion spent annually. The largest category of expenditure is well plugging and abandonment (P&A) at 49 per cent (£8.3 billion). Some depleted oil and gas fields, and oil and gas infrastructure, may potentially be used in the emerging CCS sector (see section A.3).

A.8.4 Assumptions on Future Activity

Future oil and gas development depends on the presence of exploitable resources and the economic viability of development. Information on proposed front-end development activity (resource surveys and exploration/appraisal wells) is available from awards made under OGA's oil and gas licensing rounds. However, it is difficult to anticipate the extent to which this front-end activity might subsequently lead to development projects. Furthermore, information from recent and current licensing rounds provides a relatively short-term view of future activity. OGA initiated a 30th licensing round in July 2017. On 23rd May 2018, OGA announced the first awards under this licensing round. None of these awards are within 10 km of any of the pMPAs and therefore the exploration would be unaffected, however there is potential for pipelines to cross the pMPA sites.

[139] Oil and Gas Authority. 2017. Decommissioning Insight 2017. Available at: https://cld.bz/BoPAqso/4/

A significant proportion of existing oil and gas infrastructure will be decommissioned over the next 20 years. Information on draft and approved decommissioning programmes is available from BEIS[140]. However, this provides only a short-term view on future decommissioning activity. Further decommissioning plans are likely to be brought forward during the time period of the impact assessment.

It has been assumed that no new gas storage sites and no new gas interconnector projects are developed in waters off Scotland within the assessment period.

A.8.5 Potential Interactions with pMPA Features

Infrastructure for the exploration and drilling for oil and gas may interact with the pMPA features in a number of ways. Without appropriate mitigation, seismic surveys in the exploration for oil and gas can cause significant impacts or disturbance to a variety of marine species, particularly fish and marine mammals. Construction and operation of oil and gas exploration and production facilities may also cause visual and noise disturbance to these features. The installation of drilling infrastructure and drilling activities will have direct impacts on local benthic features. Benthic species may suffer lethal effects of surface and sub-surface abrasion and penetration. Disturbance and smothering may occur with the dispersion and deposition of drill cuttings, although this is dependent on hydrodynamic conditions and the particle size of the drill cuttings. Noise disturbance may also result from drilling activities. Once installed, the presence of drilling infrastructure has the potential to interrupt hydrodynamic processes and change local patterns of sediment erosion and deposition. Scour protection to avoid potentially adverse impacts associated with erosion may involve replacing the original soft sediment on the seabed with a rocky substrate, inducing changes in habitat and community structure. Once in place, drilling infrastructure may potentially result in death or injury by collision of mobile species[141] .

Trenching and burying of pipelines for the transport of oil and gas causes short-term disturbance to the benthic habitat along the route of the pipeline, after which the seabed would be re-colonised (although it is noted that recovery times will vary dependent on the habitat present). If pipelines are laid directly on the seabed, they may disrupt the hydrodynamic regime and alter the natural transport of sediment within the area. Concrete mattresses may be utilised to stabilise pipelines, resulting in a permanent loss of soft sediment habitat and a shift to hard substrate. In areas of sand waves, sand crests may be ‘shaved’ to flatten the seabed for better pipeline installation, altering geomorphological characteristics of the area[142].

Oil spills can impact all habitat types, although areas of low wave energy are more vulnerable than high energy areas that can naturally disperse oil quickly. In addition to oil pollution, discharges of formation water, crude oil and other production chemicals

[140] BEIS, 2018b. Digest of United Kingdom energy statistics 2018. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/736148/DUKES_2018.pdf

[141] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

[142] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

may affect the surrounding environment if not managed in accordance with best practice.

It should be noted that potential environmental impacts are managed through the licensing/regulatory system; for example, geological surveys as part of oil and gas industry operations are regulated by BEIS.

A.8.6 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Additional assessment of the impact of the development proposal on pMPA features;
- Following 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 cables / pipeline routes should avoid northern sea fan and sponge communities (SEB);
- Follow existing best practice mitigation measures / guidance to minimise impacts of noisy activities;
- No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR); and
- No noisy activities during Risso's dolphin high season (May – October) (NEL).

No potential management scenarios have been identified in relation to decommissioning and it has therefore been assumed that the designations will not impose significant cost impacts on this activity. There are no oil and gas fields or production facilities overlapping with the proposed pMPAs and it is therefore unlikely that any significant decommissioning activity would be required in these areas. There is potential for decommissioning of pipeline infrastructure, however the extent of this is unknown, and some infrastructure is currently being considered for re-use in CCS industries (as discussed above).

No measures are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

A.8.7 Assessment Methods

<u>Additional assessment of the impact of the development proposal on pMPA features</u>

It has not been possible to predict the number of new pipeline applications associated with licence blocks over the assessment period, therefore the impact on application costs to the industry cost cannot be quantified. In addition, given the maturity of the North Sea

fields it is unlikely that any new export pipelines would be constructed; rather any developments would be likely to tie in to existing infrastructure.

Following 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)

Existing best practice is already being followed therefore there is assumed to be no additional cost to this management measure.

New cables / pipeline routes should avoid northern sea fan and sponge communities (SEB)

There are currently no proposed pipelines, or expected future oil and gas development which will impact on features within the SEB pMPA. There is therefore assumed to be no cost associated with this management measure for the oil and gas industry.

Follow existing best practice mitigation measures / guidance to minimise impacts of noisy activities

No seismic surveys are currently planned as part of any of the DECC licensing awards within 10km of the pMPA. It has therefore been assumed that this measure will not give rise to any significant cost impact based on current exploration proposals.

No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR)

No seismic surveys are currently planned as part of any of the DECC licensing awards within 10km of the pMPA. There is potential for pipelines connecting to licenced blocks to intersect the STR pMPA. The routes will require survey, which would, under this management measure be restricted to November to March, however the likelihood of requirement for future pipelines intersecting the pMPAs is unknown and there is therefore not sufficient evidence upon which to base an assessment.

There are 154 nm of current pipeline within the pMPAs (exclusively STR) which are assumed to require annual survey.

This survey activity within the STR pMPA will be required to be undertaken November – March, and there is increased likelihood of weather downtime during this period. To assess any impact of increased downtime it has been assumed that this will double the time taken to undertake the survey. As such 3 days of survey time, which would take 4 days in summer (with 1 day of weather downtime) will take 8 days in winter (with 5 days of weather downtime). The additional downtime for a 3 day survey is therefore 4 additional days.

It has been assumed that downtime costs are £10,000 per day at 2019 prices.

It has not been possible to predict the number of new pipeline applications requiring survey associated with licence blocks over the assessment period, therefore the impact of this management measure on survey cost cannot be quantified.

Cost of uncertainty and delays

The designation of the MPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

A.8.8 Limitations

- Uncertainty concerning the location, scale and timing of future development activity, particularly in later years of the assessment period; and
- Uncertainty concerning the cost impact of project delays associated with additional assessment requirements.
- All costs related to weather related downtime, are estimates only, as in reality conditions may be better or worse and costs will vary.

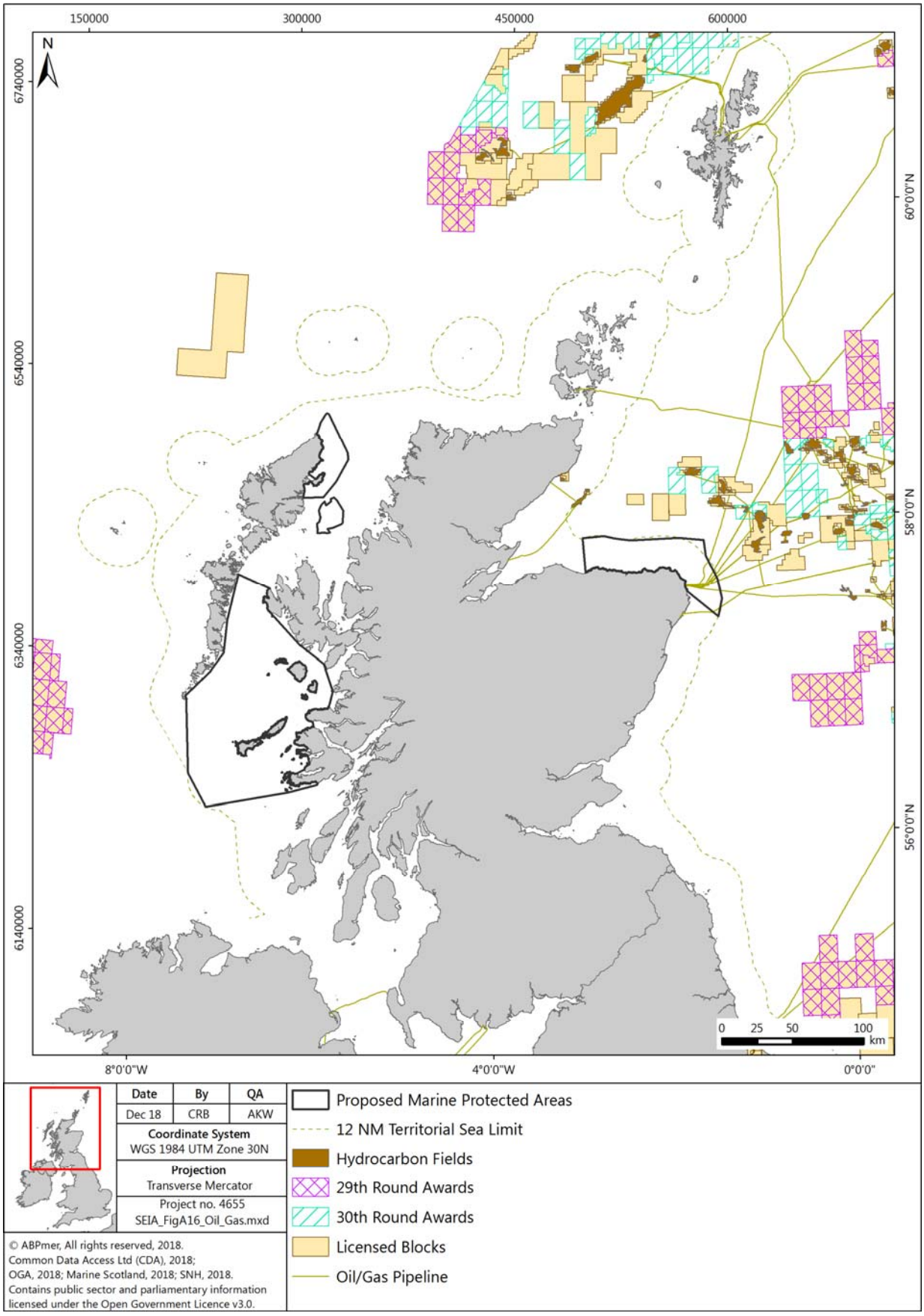


Figure A16 Current and potential oil and gas infrastructure in Scottish waters

A.9 Ports and Harbours

A.9.1 Sector Definition

Ports provide the modal interchange points by which goods and people are transported from land to sea. Harbours are, by definition, safe havens for vessels to reside and are often commensurate with port areas. This assessment focuses on potential impacts to terminals and wharves, navigation channels and approaches, anchorages and dredge material disposal sites.

A.9.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A13.

Table A13 Ports and harbours information sources

Scale	Information Available	Date	Source
Scotland	Information on how Scottish ports can develop and contribute to the economy	To 2018	British Ports Association[143]
Scotland	Economic contribution of maritime sector in UK and Scotland	2015	Centre for Economics and Business Research (Cebr)[144,145]
Scotland	Scottish Transport Statistics. 2017 Edition	2016	Transport Scotland[146] and Department for Transport (DfT)[147]
Scotland	Commercial listings of ports in Scotland, service providers, contact details, description of services and current development plans (Scotland)	Current	Ports of Scotland: http://www.portsofscotland.co.uk/
UK	Port and harbour locations, port types, port ownership, contact details (UK)	Current	Ports and Harbours of the UK: http://www.ports.org.uk/
UK	Marine traffic, passenger numbers and cargo volume	Up to 2017	DfT[148]

Location and intensity of current activities

Within Scottish waters, the ports and harbours sector supports the largest fishing industry in the UK, provides facilities for a significant offshore oil and gas industry, as well as maintaining ferry links to island communities and providing the recreational sector with support services. There is an intrinsic link between ports, harbours and shipping, however the interactions and issues in relation to protected sensitive marine

[143] British Ports Association (BPA), 2018. Scottish Ports: Gateways for Growth. Available at: tinyurl.com/y8okh8ak

[144] Cebr 2017a. The economic contribution of the Maritime sector in Scotland. A report for Maritime UK

[145] Cebr, 2017b. The economic contribution of the UK Maritime Sector. A report for Maritime UK.

[146] Transport Scotland. 2018. Scottish Transport Statistics. No. 36, 2017 Edition.

[147] Department for Transport (DfT) 2017. Transport Statistics Great Britain 2017.

[148] Department for Transport (DfT) 2017. Transport Statistics Great Britain 2017.

features are often distinctly different. Information for recreational boating and commercial shipping are presented in sections A.11 and A.12 respectively.

There are 11 Scottish ports classified under the EC Maritime Statistics Directive as major ports as they handle at least one million tonnes of cargo per year; an additional five major Scottish ports are also reported by the Scottish Government (see Figure A17).

Overall, there are around 270 ports and harbours in Scottish waters, ranging from very small piers and landing stages, to those with major facilities. They include:

- Large Oil and Gas terminals, e.g. Hound Point (Firth of Forth), Sullom Voe (Shetland), Flotta (Scapa Flow, Orkney);
- Large quarry product port, e.g. Glensanda;
- Large fishing ports, e.g. Peterhead, Fraserburgh;
- Smaller fishing ports, e.g. Buckie, Mallaig;
- Oil supply ports, e.g. Aberdeen, Cromarty Firth;
- Multi-purpose ports, e.g. Leith, Clyde;
- Large container ports, e.g. Grangemouth; and
- Major ferry ports serving Ireland and Europe, e.g. Cairnryan, Stranraer and Rosyth.

Anchorages are located all around the Scottish coastline in inshore waters but are located in highest densities on the west coast, in Orkney, the Moray Firth and the Firth of Forth.

Cargo and passenger figures are published each year in the Scottish Transport Statistics and the Department for Transport Maritime Statistics[149,150]. In 2016, 66.7 million tonnes of cargo were handled by all Scottish Ports and 10.1 million passengers were carried by ferries, with 33,000 vessels arriving at Scottish Ports from Europe during the same period. In 2015, a total of 44.5 million tonnes of freight was recorded as being lifted by water transport in Scotland: 14.2 million tonnes of coastwise traffic to other ports in the UK (including Scotland), and 2.2 million tonnes of one port traffic to offshore installations (2014 figure).

Economic value and employment

The Cebr estimated GVA and numbers of jobs for port-related[151] activities within Scotland in 2015 as £598 million and 3,600, respectively[152].

[149] ibid

[150] Transport Scotland, 2018. Scottish Transport Statistics. No. 36, 2017 Edition.

[151] Includes; Warehousing and storage; Port Authority Management, Security and Marshals, Marine and Vessel Management Services, Marine Pilots, Harbour Support, Engineering and Maintenance; Stevedores, cargo and passenger handling including crane/vehicle/plant drivers/operators; and Border Agency, Home Office and HMRC staff operating in Ports.

[152] Cebr 2017a. The economic contribution of the Maritime sector in Scotland. A report for Maritime UK

Smaller-scale local ferry services, mainly between the Scottish mainland and outlying islands provide an important lifeline for residents. This service also opens a gateway for tourists to visit areas that might be otherwise inaccessible by car or train. Examples of this type of link include services provided by CalMac, Orkney Ferries, Northlink Ferries and Shetland Islands Council. For example, the total number of passengers carried on routes within Scotland was 8.3 million in 2016. CalMac accounted for 61% of the total passenger numbers on all these services[153] . This provides considerable economic and social benefit to both the port and harbour operators as well as the surrounding area, allowing for the movement of commercial traffic, local passenger traffic and growing numbers of tourists and visitors[154] .

Future trends

Scotland's National Marine Plan[155] set out five objectives for "Shipping, Ports, Harbours and Ferries". These make sure the industry is safeguarded and developed as it is a key part of Scotland's economy. This provides confirmation that the ports industry is supported by Government policy into the future, providing assurance of sustained development.

The future use, growth and development of ports are intrinsically linked to world trade patterns and the economic climate, and are reactive to changing economic circumstances. Due to uncertainty regarding the process of Brexit and the implications for the UK economy and the associated maritime sector, it has been forecast that the maritime industry GVA and turnover will remain flat until 2019, followed by slow growth up to 2022. By 2022 GVA and turnover are forecast to be around 15% and 13% higher than they were in 2015[156].

A.9.3 Assumptions on Future Activity

The timing, location and nature of port development is difficult to predict as it occurs in response to demand. In the absence of information on future port development, it has been assumed for the purposes of this assessment that major ports will undertake one development every five years over the assessment period (starting in 2021) and that all other ports will undertake one development over the period of the assessment (assumed to be in 2025).

It has been assumed that operators will need to apply for dredge material disposal licences once every 3 years. It has been assumed that locations of commercial anchorages and disposal sites do not change over the assessment period.

A.9.4 Potential Interactions with pMPA Features

The main impacts of the construction and operation of ports and harbours within pMPAs relate to direct damage to seabed habitats and species as a result of dredging or

[153] Transport Scotland. 2018. Scottish Transport Statistics. No. 36, 2017 Edition.

[154] Fraser of Allander Institute, 2015. The Economic and Social Impact of CalMac Ferries Ltd on Scotland.

[155] Scottish Government, 2015. Scotland's National Marine Plan. Available at: https://www.gov.scot/Publications/2015/03/6517

[156] Cebr, 2017b. The economic contribution of the UK Maritime Sector. A report for Maritime UK.

reclamation. Dredging may also lead to elevated concentrations of suspended sediment in the water column and potential resuspension of contaminants affecting local water quality. Re-deposition of this sediment has the potential to cause smothering of existing seabed habitats. During construction and operational phases, underwater noise and vibration may also be an issue for marine mammals and fish[157].

A.9.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Additional assessment new of development proposals affecting MPAs to support planning/marine licence applications;
- Additional assessment of maintenance dredging disposal licence applications affecting MPAs to support marine licence applications;
- Follow existing best practice mitigation measures / guidance and licensing process;
- No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR);
- No noisy activities during Risso's dolphin high season (May – October) (NEL);
- Minimise footprints of development to limit disturbance to burrowed mud (STR) and sandeel habitats;
- Produce vessel management plans as required by licensing; and
- Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October.

Where the pMPAs overlap with existing designated sites, it is possible that existing or planned management measures will contribute to achievement of the conservation objectives for the pMPAs. Assumptions on the management scenarios assessed are presented in Appendix D. The site assessments (Appendix C) provide further information on how these assumptions have been applied to individual sites.

No measures are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

A.9.6 Assessment Methods

<u>Assessment of new development proposals affecting MPAs</u>

Costs have been assessed based on the following assumptions for all scenarios:

[157] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

- New development proposals affecting MPAs will require additional assessment of impacts to protected features, as required under the Marine (Scotland) Act 2010. This information would either be reported within the EIA if required, or as a separate MPA assessment;
- Additional assessment costs for licence application are estimated to be £7,600[158] (at 2019 prices);
- Costs are incurred by all major ports within 5km of pMPAs or all non-major ports within 1km of pMPAs; and
- All major ports submit development applications every 5 years starting in 2021 and all other ports submit development applications every 20 years starting in 2029.

The average estimated costs for additional assessment are based on figures used within the MCZ IA (Annex H12 of Defra, 2012[159]).

Follow existing best practice mitigation measures / guidance and licensing process

Best practice is already being followed by ports and harbours, and therefore there is no additional cost associated with this management measure.

No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR)

It has been assumed that this seasonal restriction can be accommodated through careful timing of noisy construction activity without any significant impact on costs.

No noisy activities during Risso's dolphin high season (May – October) (NEL)

It has been assumed that this seasonal restriction can be accommodated through careful timing of noisy construction activity without any significant impact on costs.

Minimise footprints of development to limit disturbance to burrowed mud (STR) and sandeel habitats (all MPAs)

The location of the ports and harbours are such that they are unlikely to significantly impact sandeel or burrowed mud habitats. There is therefore assumed to be no cost associated with this management measure.

[158] Figure uprated from 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. The figure for Ports and Harbours is higher than for other sectors to reflect that licence applications can be more complex in this sector, potentially combining a variety of construction activities as well as dredging).

[159] 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

Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October

It has been assumed that ports or harbours within the Shark Awareness Zones (Canna, Tiree and Coll) would be required to issue a Notice to Mariners, to inform mariners of the speed restriction. This is assumed to have a one-off cost of £1,000 at 2019 prices.

Follow best practice for Marine Disposal Sites

It is assumed best practice is already being followed. Therefore, there is no cost associated with this management measure.

Siting of new marine disposal sites to minimise impacts on burrowed mud (STR) and sandeel habitat

It is assumed that no new marine disposal sites are likely to be characterised during the assessment period, therefore there is no cost associated with this management measure.

Cost of uncertainty and delays

The designation of pMPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

A.9.7 Limitations

- The location, nature and timing of future port development activity is uncertain; and
- The requirements for management measures are uncertain.

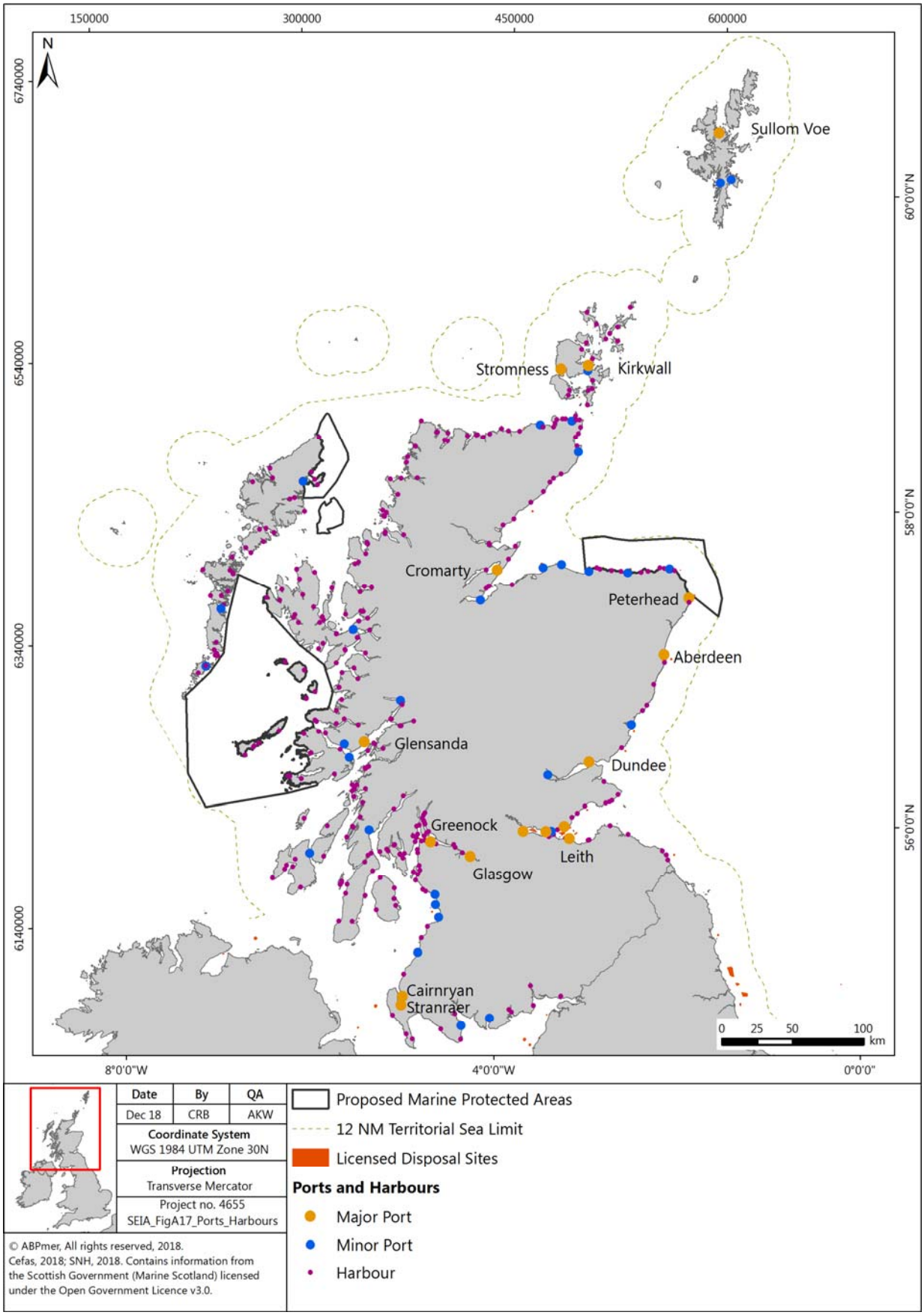


Figure A17 Major and minor port and harbour infrastructure in Scottish waters

A.10 Power Interconnectors and Transmission Lines

A.10.1 Sector Definition

This sector is concerned with the transmission of power through submarine cables, including international, national and inter-island links. This assessment excludes power cables to/from individual developments (e.g. power supplies to oil and gas installations, export cables from offshore wind farms).

Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A14.

Table A14 Power interconnectors and transmission lines information sources

Scale	Information Available	Date	Source
Scotland	UK Transmission network, including interconnectors	Current	Ofgem website https://www.ofgem.gov.uk/electricity/transmissionnetworks/electricity-interconnectors
Scotland/UK	Power interconnectors and Transmission Lines	Current	KIS-ORCA
Scotland	Power cables (submarine electricity cables)	2010	Baxter et al. (2011)
Scotland	Future power interconnector cables and transmission lines	Current	ENSG, 2014
UK	Future Projections for the National Electricity Transmission System	Current	National Grid
Scotland	Potential future subsea cable developments / reinforcements	2014	National Planning Framework for Scotland 3 (Scottish Government, 2014)

Location and intensity of activity

There are approximately 900 km of submarine power cables in Scottish waters[160] predominately created to connect island communities to the mainland national grid infrastructure[161]. This is reflected in Figure A18 which shows subsea grid infrastructure connections in inshore waters between areas of mainland Scotland and between the mainland and islands. Note, subsea power cables to/from developments (e.g. oil and gas platforms) are not shown.

[160] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[161] United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra. gov.uk/

Economic value and employment

There is no agreed methodology for calculating the economic value of subsea power cables. In the absence of information on economic value, the capacity of interconnector cables may be used as an indicator of both value and activity[162].

Future trends

The location of offshore renewables resources, often remote from locations of power demand, and the large proposed expansion of offshore renewables development may drive the development of an offshore grid network and interconnectors.

UKMMAS[163] reported that over the period 2007-12 the Office of the Gas and Electricity Markets (Ofgem) provided for capital investment of up to £4.3 billion in the electricity transmission network, an increase of 160% over the previous 5-year price control period, with much of this investment planned for Scotland.

The Scottish National Planning Framework 3[164] identifies 'electricity grid reinforcements' as a key developments essential to the delivery of the spatial strategy and to realise the potential benefits to Scottish regions. The strategic grid reinforcements are essential to provide the transmission capacity necessary to realise the potential of Scotland's renewable energy sources, maintain long-term security of electricity supply and support sustainable economic development. This development would occur throughout Scotland, from the English border to the Shetland Islands and, in relation to marine power interconnectors and transmission lines, would include:

- The Caithness-Moray HVDC transmission link was commissioned at the end of 2018 and is now providing an additional 1.2 GW of transmission capacity in the north of Scotland[165].
- Scottish and Southern Electricity Networks (SSEN) plan to connect Shetland to the National Electricity Transmission System for the first time by 2021. The proposal includes a sub-sea, 260-km long, 60 MW cable with on-island backup generation to replace Lerwick power station. It is currently in the early stages of development.
- In August 2018, SSEN submitted a final needs case to Ofgem to obtain permission for a 600 MW subsea cable transmission link between the Western Isles and the Scottish mainland. The company referenced the UK Government's decision to allow remote island onshore wind to be included in future Contracts for Difference (CfD) auctions. The existing Western Isles

[162] United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra. gov.uk/

[163] ibid

[164] Scottish Government, 2014. National Planning Framework for Scotland 3.

[165] Committee on Climate Change. 2018. Reducing emissions in Scotland. Available at: https://www.theccc.org.uk/publication/reducing-emissions-in-scotland-2018-progress-report-to-parliament/. Accessed 08/10/2018.

network is close to full capacity and it is unlikely that further generation could connect without significant reinforcement[166].

- There is a North Connect project proposing to develop a 665 km, 1400 MW HVDC interconnector between Peterhead in Scotland and Simadalen in Norway. It will provide an electricity transmission link between the two nations to exchange power and increase the use of renewable energy. The intention is for the HVDC interconnector to be operational by 2023[167].
- The Maali interconnector is proposed to link Shetland to Norway[168], to provide for the transfer of energy from proposed wind farms on the islands to Norway in periods of high production, and from Norway in periods of low wind;
- In addition, it is noted that Scottish and Southern Electricity Networks (SSEN) is at the beginning of a long-term replacement programme for all the existing distribution cables[169].

The Electricity Ten Year Statement (ETYS) is produced every year by National Grid in its role as Transmission Owner (TO) and System Operator (SO). Its purpose is to illustrate what the future National Electricity Transmission System (NETS) could look like, and describe how it could operate, under a range of plausible Future Energy Scenarios. The most recent report in 2017[170] concluded that within Scotland the anticipated increase in renewable generation will increase requirements for power transfer across boundaries within Scotland and cross-borders. The Network Options Assessment[171] has identified 12 critical options that are recommended to be taken forwards with delivery during the 2020s. The analysis[172] has confirmed the need to progress and projects such as the Eastern HVDC should continue as planned.

The Irish-Scottish Links on Energy Study (ISLES) is a major initiative designed to facilitate the development of future renewable energy developments through an interconnected offshore electricity network in the offshore areas of Ireland, Northern Ireland and Scotland. It is hoped that such a network could provide significant economic benefits as well as helping to make a material contribution to climate change and renewable energy targets through the connection of approximately 6.2 GW (gigawatts) of renewable generation[173].

[166] Scottish Government, 2014. National Planning Framework for Scotland 3

[167] North Connect. 2018. HVDC Cable Infrastructure- UK Construction Method Statement. Available at: http://northconnect.no/file/hvdc-cable-infrastructure-uk-construction-method-statement.pdf. Accessed 08/10/2018.

[168] European Network of Transmission Systems. Undated. Project 294- Maali. Available at https://docstore.entsoe.eu/Documents/TYNDP%20documents/TYNDP%202016/projects/P0294.pdf. Accessed 24/10/2018

[169] SSEN, undated. Submarine Electricity Cable replacement works, [online] available at http://news.ssen.co.uk/submarinecables/

[170] National Grid, (2017). Electricity Ten Year Statement 2017.

[171] National Grid, (2018). Network options Assessment 2017/2018.

[172] ibid

[173] AECOM & ABPmer, (2015). ISLES II Spatial Plan: Sustainability Appraisal - Socio-economic Impact Assessment.

A.10.2 Assumptions on Future Activity

It has been assumed that all currently planned and proposed interconnector projects identified by the National Grid as key infrastructure developments will be constructed in the period to 2023.

A.10.3 Potential Interactions with pMPA Features

The installation and operation of submarine power cables will have similar effects on pMPA features as that of telecom cables (also see section A.13). The burying of cables in the seabed generally involves the use of jetting or a plough, disturbing the local seabed area and producing temporary sediment plumes. Sediment may also be removed from the seabed. The overall level of disturbance to sediments and benthic fauna is, however, likely to be minimal and impacts on pMPA features likely to be short-lived, although recovery rates vary between environments. Sandy and mixed sediment environments, for example, recover more rapidly from disturbance than intertidal sediments supporting biogenic reefs and macrophyte assemblages[174].

Where cable burial is not feasible, mattressing, grout bags or rock dumping may be used. The effects of these techniques may lead to a direct loss of habitat in the surrounding area, particularly where rock dumping may create a hard substrate on originally soft sediment, which may also provide a pathway for invasive non-native species to migrate across an area[175]. During cable installation, vessels will need to be anchored, causing abrasion to the local seabed, and underwater noise will also be generated by the presence of vessels.

During cable installation or maintenance activities there is a risk of visual or noise disturbance of fish and marine mammals. There is also some potential for collision risk.

The potential impacts of submarine power cable installation and use are likely to be short-term and the impacts on the seabed will remain local. JNCC and Natural England state that in most cases the installation of cables has no significant impact on marine features in an area[176].

In addition to these impacts, during operation, interconnecting power cables induce electromagnetic changes in the local environment that are detectable by some electro-sensitive and magneto-sensitive species, notably elasmobranchs and cetaceans. The significance of these effects for individuals and populations remains uncertain[177]. Operational cables on or under the seabed may also generate heat, leading to localised warming of the seabed.

[174] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

[175] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

[176] ibid

[177] ibid

In addition, in order to maintain the cables, it is expected that there is a requirement to regularly survey power interconnectors, therefore there is potential for survey vessels, and noise emitting survey equipment to cause disturbance to fish and marine mammals.

Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required within 12nm to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Additional assessment for new development proposals affecting MPAs to support marine licence applications;
- Following 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 cables / pipeline routes should avoid northern sea fan and sponge communities (SEB);
- Follow existing best practice mitigation measures / guidance and licensing process for noisy activities;
- No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR);
- No noisy activities during Risso's dolphin high season (May – October) (NEL).

No measures are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

A.10.4 Assessment Methods

Additional assessment to inform marine licensing

It has been assumed that an additional cost of £5,600 (at 2019 prices) will be incurred to provide information to the regulator concerning the potential impact of new interconnector projects on protected features, as required under the Marine (Scotland) Act 2010. This information would either be reported within the EIA if required, or as a separate MPA assessment. The assumed assessment dates for individual cables are identified in Table 4 of each relevant site impact assessment (see Appendix C).

It is assumed that the only project that will undergo the application process during the assessment period is the Western Isles transmission reinforcement. The application is expected to be in 2019.

Following 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)

Existing best practice is already being followed therefore there is assumed to be no additional cost to this management measure.

New cables / pipeline routes should avoid northern sea fan and sponge communities (SEB)

There is one proposed interconnector (Western Isles), but this is not routed through SEB pMPA and therefore it is assumed that there is no cost to power interconnectors associated with this management measure.

Follow existing best practice mitigation measures / guidance and licensing process regarding noisy activities

Best practice is assumed to be currently followed, and therefore there is no additional cost associated with this management measure.

No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR)

There is one current marine transmission development, the Moray-Caithness grid reinforcement project (STR). This is currently entering the construction phase, and therefore pre-consenting surveys have been completed, however there is potential for the seasonal restriction to impact post-construction operational and monitoring surveying with first costs in 2019. It has been assumed that a single survey would be required annually to check the condition of the cabling. This survey, specifically the approximately 12 nm of cable within STR, is assumed to take 3 days of survey time to cover three transect lines

This survey activity within the STR pMPA will be required to be undertaken November – March, and there is increased likelihood of weather downtime during this period. To assess any impact of increased downtime it has been assumed that this will double the time taken to undertake the survey. As such 3 days of survey time, which would take 4 days in summer (with 1 day of weather downtime) will take 8 days in winter (with 5 days of weather downtime). The additional downtime for a 3 day survey is therefore 4 additional days.

It has been assumed that downtime costs are £10,000 per day at 2019 prices.

No noisy activities during Risso's dolphin high season (May – October) (NEL)

There is a future project which transects NEL pMPA (Western Isles). It is assumed that large scale geophysical surveys have been undertaken, and that costs associated with this will be annual surveys, with first cost in 2022 following installation in 2021. It has been assumed that a single survey would be required annually to check the condition of the cabling. This survey, specifically the approximately 10 nm of cable within NEL pMPA, is assumed to take 3 days of survey time to cover three transect lines.

This survey activity within the NEL pMPA will be required to be undertaken November – March, and there is increased likelihood of weather downtime during this period. To

assess any impact of increased downtime it has been assumed that this will double the time taken to undertake the survey. As such 3 days of survey time, which would take 4 days in summer (with 1 day of weather downtime) will take 8 days in winter (with 5 days of weather downtime). The additional downtime for a 3 day survey is therefore 4 additional days.

It has been assumed that downtime costs are £10,000 per day at 2019 prices.

Cost of uncertainty and delays

The designation of pMPAs has the potential to increase the time taken to determine licence applications and to negatively affect investor confidence. It has not been possible to quantify these potential impacts.

A.10.5 Limitations

- The number and location of interconnectors that may be constructed up to 2030 is uncertain and beyond 2040 is unknown;
- The requirements for management measures are uncertain; and
- All costs related to weather related downtime, are estimates only, as in reality conditions may be better or worse and costs will vary.

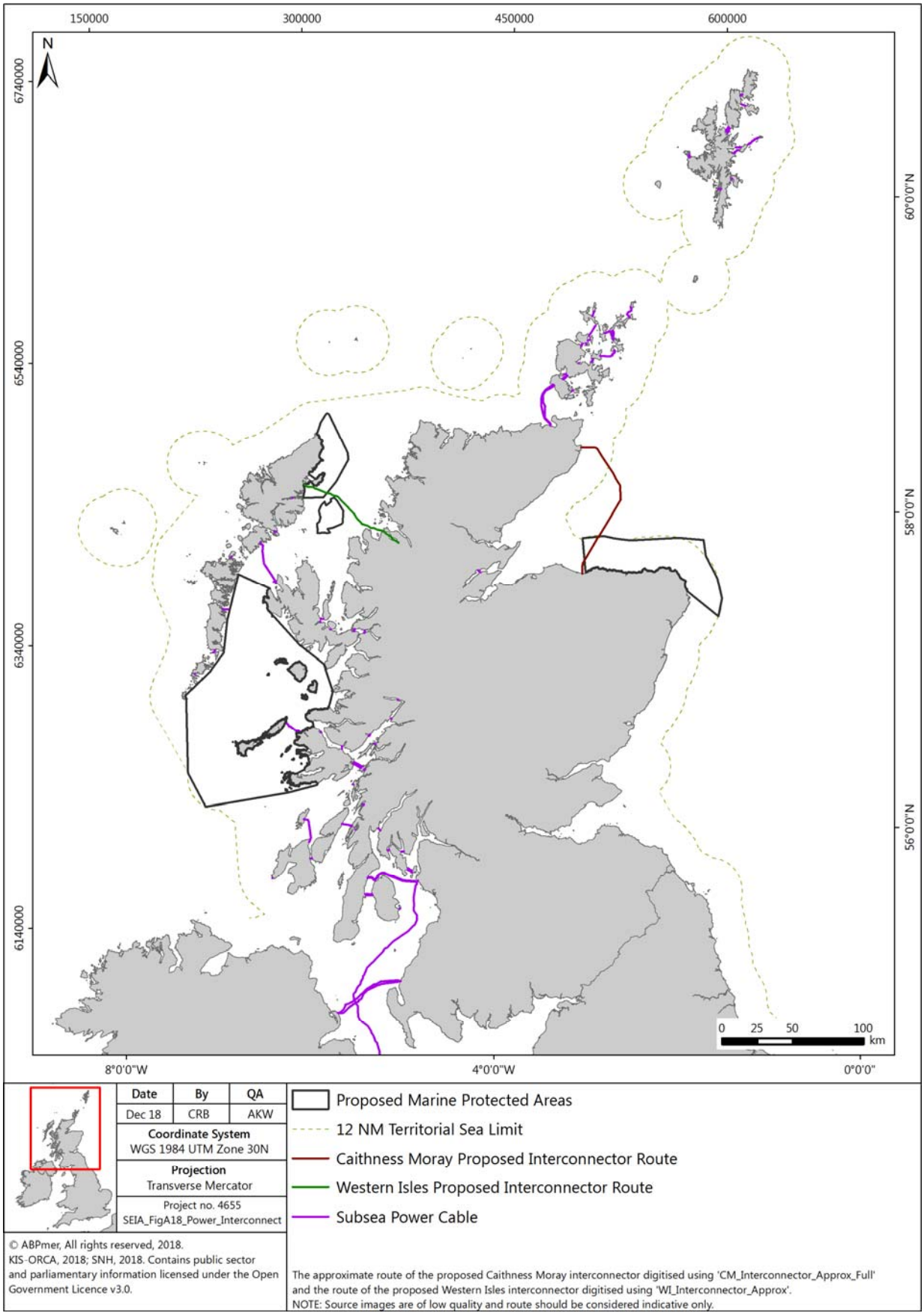


Figure A18 Current and potential power interconnectors in Scottish waters

A.11 Recreational Boating

A.11.1 Sector Definition

For the purpose of this study, recreational boating is considered to include recreational activities undertaken in medium and large sailing vessels, yachts, powerboats and motorboats. Information on small sailing boat activity such as dinghies (usually taken out of water at end of use) and other types of water sports are covered under water sports. It is possible that general tourism values may overlap with values specifically associated with recreational activities. General tourism is described separately in Appendix A.14. There is some possibility of a degree of double counting using this approach but not to the extent that it materially affects the results of the study.

A.11.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A15.

Table A15 Information sources for recreational boating

Scale	Information Available	Date	Source
Scotland	Statistics on sailing tourism	2009-2016	EKOS Limited (2016)
Scotland	Marina Locations	Current	https://www.sailscotland.co.uk/sail/
Scotland	Number of resident home berths Number of visiting berths Proportion of total Scotland berths Demand for home berths (occupancy) Visiting craft demand for berths Average annual spend per boat (high, medium and low) Direct expenditure Multipliers (from Scottish Tourism Multiplier Study) Visiting boat nights Visiting boat expenditure Employment Gross Value Added	2009-2016	EKOS Limited (2016)
Scotland	Scottish marine recreation and tourism (Scotland)	2016	Scottish marine recreation and tourism survey 2015 http://www.gov.scot/Topics/marine/seamanagement/national/RecandTourism
Scotland	Strategy for future development of sailing tourism and marine tourism in Scotland	N/A	Marine Tourism Development Group (MTDG), 2015.
UK	Activity 'heat map' (AIS intensity), general boating areas, offshore routes, RYA clubs and training centres, marinas (UK/Scotland)	2016	UK Coastal Atlas of Recreational Boating, 2016 http://www.rya.org.uk/knowledge-advice/planning-environment/Pages/uk-coastal-atlas-of-recreational-boating.aspx
UK	Boat Launch – Slipways	Current	Boat Launch (www.boatlaunch.co.uk)

Scale	Information Available	Date	Source
UK	Recreational boating statistics 2016 (UK)	2016	ICOMIA recreational boating statistics 2016 https://www.britishmarine.co.uk/Resources/Publications/2017/November/ICOMIA-Recreational-Boating-Industry-Statistics-2016 (British Marine membership required for access)
UK	Water sports Participation Survey	2017	Arkenford, 2017 https://www.rya.org.uk/SiteCollectionDocuments/sportsdevelopment/2017-watersports-study-final-summary.pdf

Location and intensity of activity

The Scottish coast, and particularly the west coast, is identified as being one of the world's premier destinations for sailing.

The UK Atlas of Recreational Boating[178] and data from the Royal Yachting Association (RYA) indicates that recreational boating within Scotland is concentrated in the Clyde and along the west coast, the Moray Firth, Solway Firth and the Firths of Tay and Forth which are the traditional cruising grounds for recreational sailors and power boaters (Figure A19). However, recent developments along the east coast, and within the Orkney and Shetland Isles have increased the potential for cruising routes between the Caledonian Canal and the Shetlands with well-placed facilities and stopping points en route. The RYA's Position Statement on offshore energy developments[179], which encompasses the whole of the UK, notes that most of the general day sailing and racing areas are close to the shore.

Indicative estimates of the number of people participating in sailing and power/motor boating activities in Scotland can be taken from the Water Sports and Leisure Participation Survey 2017[180]. This report estimated that in 2017 in Scotland 273,000 people participated in any boating activity, incorporating sailboat activities, yacht racing / cruising, power / motor boating, canal boating, canoeing, rowing, windsurfing and water-skiing. The British Marine Federation (BMF) reported a total of 36 coastal marinas in Scotland in 2014 which represents approximately 15% of the UK total[181].

Economic value and employment

An assessment of the economic impact of sailing in Scotland was undertaken by EKOS (2016) and a summary is shown below in Table A16. The study indicated that there was a total berthing/mooring capacity available across Scotland for 15,700 vessels in

[178] RYA, (2016). UK Coastal Atlas of Recreational Boating. Third Edition.

[179] RYA, (2015). The RYA's Position on Offshore Energy Wind Developments.

[180] Arkenford, (2018). Watersports Participation Survey 2017.

[181] BMF (2014). BMF Research Overview – Marinas.

2016[182]. It is estimated that sailing tourism in Scotland contributed £67.7 million GVA in 2016 and supported 2,740 FTE jobs[183].

Table A16 Economic impact of sailing in Scotland in 2016

Activity	Total Activity (by Scottish and Non-Scottish Boat Owners)	Tourist Activity (by Non-Scottish Boat Owners Only)
Expenditure	£130.1 million	£38.9 million
Employment (FTEs)	2,740	820
GVA	£67.7 million	£20.2 million

(Source: EKOS, 2016[184])

Figure A19 shows an overview of recreational boating activity in Scotland, with respect to the location of RYA clubs and training centres, marinas, general boating areas and indicative offshore routes. The figure also shows AIS intensity (a 'heatmap' of activity), although it should be noted not all recreational vessels have AIS and hence this data is likely to substantially underrepresent the activity of recreational vessels. Information sources that can be used in the assessment are listed in Table A15

Future trends

As noted above, the recreational boating industry is a growing one in Scotland, having increased in real terms by 11% from 2009-2016. In 2016, it was assessed that there is still potential for future growth in recreational boating, with waiting lists across a number of marinas, indicating that expansion of these marinas is unlikely to exceed demand in the short term[185].

The continued growth of the sector has the potential to contribute to the Scottish economy, with a growth in direct GVA from £67.7 million to £86.9 million under the highest scenario[186], with associated increases in employment of between 394 and 480 FTEs. Scotland's Marine Tourism Strategy 'Awakening the Giant' sets a target to develop and lead the growth of sailing tourism in Scotland from £101 million visitor expenditure in 2015 to £145 million by 2020[187]. It should be noted that this figure only considers expenditure at marinas / local tourism, and does not consider the wider contribution to the economy such as through boat building.

[182] EKOS Limited, (2016). Sailing Tourism in Scotland, Report for The Crown Estate, Highlands and Islands Enterprise and Scottish Canals. December 2016.

[183] ibid

[184] EKOS Limited, (2016). Sailing Tourism in Scotland, Report for The Crown Estate, Highlands and Islands Enterprise and Scottish Canals. December 2016.

[185] ibid

[186] ibid

[187] Marine Tourism Strategy Development Group, (2015). Awakening The Giant.

A.11.3 Assumptions on Future Activity

It is assumed that recreational sailing routes, recreational anchorages and sailing and racing areas do not change significantly over the period of the assessment. There is some potential for levels of activity to increase in Scottish waters, dependent on continued investment in facilities and wider economic conditions.

A.11.4 Potential Interactions with pMPA Features

The primary interactions of recreational boating with pMPA features relate to the construction and use of boating infrastructure and vessel movements. The construction of boating infrastructure such as marinas and slipways may result in a complete loss of local habitat and the potential pollution of the habitats and species within the surrounding area. The installation and use of moorings may cause further physical damage to the seabed, notably to those pMPA sub-features particularly vulnerable to disturbance. Similar effects are associated with the regular anchoring of boats. Leachates entering the environment from infrastructure may further pollute surrounding habitats and species, and increased shading as a result of infrastructure development may cause a loss of algal species and the associated infauna. Underwater noise may also be associated with construction activities[188].

There are also potential impacts to marine mammals associated with vessel movements in relation to collision risk and visual and noise disturbance. There are also risks associated with pollution from fuel, oil and lubricants. The introduction of invasive species into new habitats is also of concern. Other potential interactions of boating with pMPA features include pollution with litter, sewage, zinc anodes and physical impacts associated with boat launching, haulout and disposal[189].

A.11.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October.

No measures are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

[188] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

[189] ibid

A.11.6 Assessment Methods

Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October

It has been assumed that RYA (Scotland) is required to disseminate information regarding the speed restriction at a cost of £1,000[190]. It has been assumed that compliance with the speed restriction does not impose any significant cost on recreational boaters or the supply chain.

A.11.7 Limitations

- Future trends in recreational boating activity are uncertain.

[190] This figure is based on a small amount of time (maximum two days work) for the RYA to disseminate information regarding the speed restriction

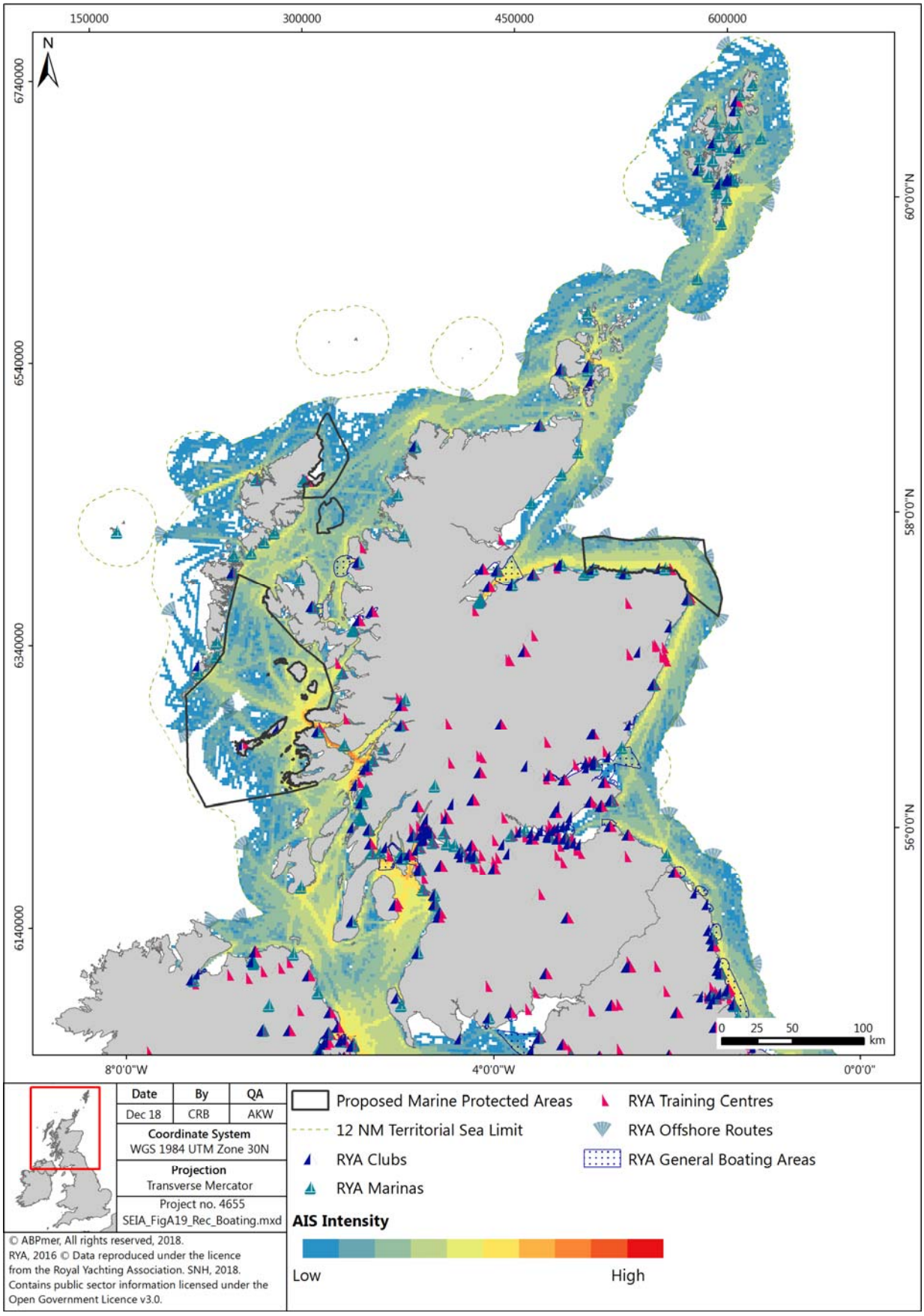


Figure A19 Recreational boating density and RYA infrastructure in Scotland

A.12 Shipping

A.12.1 Sector Definition

Shipping provides for the transport of freight and passengers both within Scottish waters and internationally. Commercial shipping routes can be split into two distinct types; transiting vessels passing through Scottish waters and vessels with either their origin or destination port within Scotland. Anchorages are covered under Ports and Harbours.

A.12.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A17.

Table A17 Shipping information sources

Scale	Information Available	Date	Source
Scotland	Scottish Transport Statistics. 2017 Edition	2016	Transport Scotland[191]
Scotland	Economic contribution of maritime sector in Scotland	2015	Centre for Economics and Business Research (Cebr)[192]
Scotland	Shipping positions processed from AIS data	Current	Maritime and Coastguard Agency (MCA) released under open Government licence by the Marine Management Organisation

Location and intensity of current activities

AIS density grid data (Figure A20) indicates that, in general, vessels move up the west coast of Scotland through the North Channel (or Straits of Moyle), the Minches, and east–west between the northern coast of the mainland and Orkney, from where vessels access the North Sea. Some of the areas showing the highest intensity of vessel movement include ferry routes (e.g. between Northern Ireland and Loch Ryan, between the Outer Hebrides and the mainland via the Sound of Mull and between the Shetland Islands, Orkney and the Scottish mainland) and around the Clyde. There is also an area of particularly high intensity of vessel movements around Fraserburgh, Peterhead and Aberdeen, related to the offshore oil and gas and fishing sectors. To minimise collision risk, some heavily-used areas have Traffic Separation Schemes (TSS) which divides opposing traffic into lanes.

Economic value and employment

In 2016, a total of 66.7 million tonnes (Mt) of freight was handled by Scottish ports. Eleven of the major ports accounted for 95% of the total freight. Exports accounted for a larger proportion of the freight handled, with 73% of the tonnage being destined for another location.

[191] Transport Scotland. 2018. Scottish Transport Statistics. No. 36, 2017 Edition.

[192] Cebr 2017. The economic contribution of the Maritime sector in Scotland. A report for Maritime UK

Cebr estimated that the shipping industry, directly and indirectly contributed £3.1 billion to the Scottish economy in 2015[193] . In 2015, the number of jobs in the shipping industry in Scotland was 5,700 (direct) with indirect and induced employment at 63,200.

Future trends

Shipping volumes bear a direct relationship to the global economic market. As markets react to the changing economic situation, shipping lines respond with services to move goods and people. The most notable variable to affect the volume and intensity of shipping into the future will be the technology and innovations used to design future shipping. Ship design seeks for bigger, faster and more economic transhipment of goods and people[194].

In respect of lifeline ferry services, which make up a significant proportion of vessel movements within Scottish waters, the Scottish Government has prepared a long-term ferries strategy (2013-2022). The Scottish Ferries Plan makes recommendations regarding where investment should be focused to improve connections for island and remote rural communities, improve reliability and journey times, maximising opportunities for employment, business, leisure and tourism and promoting social inclusion[195].

Planned and possible future offshore renewables development over the assessment period could interact with commercial shipping activity. Such development could preclude passage of commercial vessels through areas occupied by arrays with the potential to increase steaming distances and times on some routes.

A.12.3 Assumptions on Future Activity

Shipping volumes directly relate to the global economic market and also to national trends such as the development of offshore renewables. The most notable variable to affect the volume and intensity of shipping into the future is likely to be the technology and innovations used to design future shipping. It is assumed that numbers of vessels and routes remain relatively constant over the assessment period (2019 to 2038).

A.12.4 Potentially Significant Interactions with pMPA Features

The main pressure arising from commercial shipping vessels on features identified within the current list of potential pMPAs relates to disturbance to seabed habitats from anchoring (covered under Ports and Harbours) together with visual and noise disturbance and collision risk for fish and marine mammals during ship operations.

Oil spills as a result of shipping activities may impact both habitats and species proposed for protection. Other pollutants such as sewage or those released by

[193] Cebr 2017a. The economic contribution of the Maritime sector in Scotland. A report for Maritime UK

[194] ABPmer and RPA, 2013. Developing the socio-economic evidence base for offshore renewable sectoral marine plans in Scottish Waters. Report R.2045, June 2013. Appendix B.

[195] Transport Scotland. 2012. Scottish Ferry Services: Ferries Plan (2013-2022).

accidental cargo spillage also have the potential to contaminate habitats, resulting in nutrient enrichment of waters[196].

Ballast water discharge provides a key pathway for the spread and introduction of invasive non-native species which may out-compete native species and cause a shift in community structure[197]. Since the ratification of the International Maritime Organization's (IMO) Convention for the Control and Management of Ships Ballast Water and Sediment in September 2016, and entry into force in September 2017, ships need to have an approved Ballast Water Management Plan (BWMP). Each ship's BWMP sets out steps to reduce the spread of non-native species. This reduces the risk of this impact affecting the pMPA features.

A.12.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October.

A.12.6 Assessment Methods

<u>Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October</u>

Given the small size of the Shark Awareness Zones, the number of transits through these areas is limited, and the delay caused by the speed restrictions will be minimal, therefore it is assumed that there will be no additional cost to shipping associated with this management measure. In addition, it is noted that this management measure does not apply to ferry traffic.

It has been assumed that there will be a small cost (£1,000) to the UK Hydrographic Office (UKHO)[198] to update the relevant charts with the speed restriction areas.

A.12.7 Limitations

- Information on the future intensity of commercial shipping activity in Scottish Waters is uncertain.

[196] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

[197] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

[198] This figure is based on a small amount of work required, (maximum 2 days) to incorporate the Shark Awareness Zones into the UKHO nautical charts.

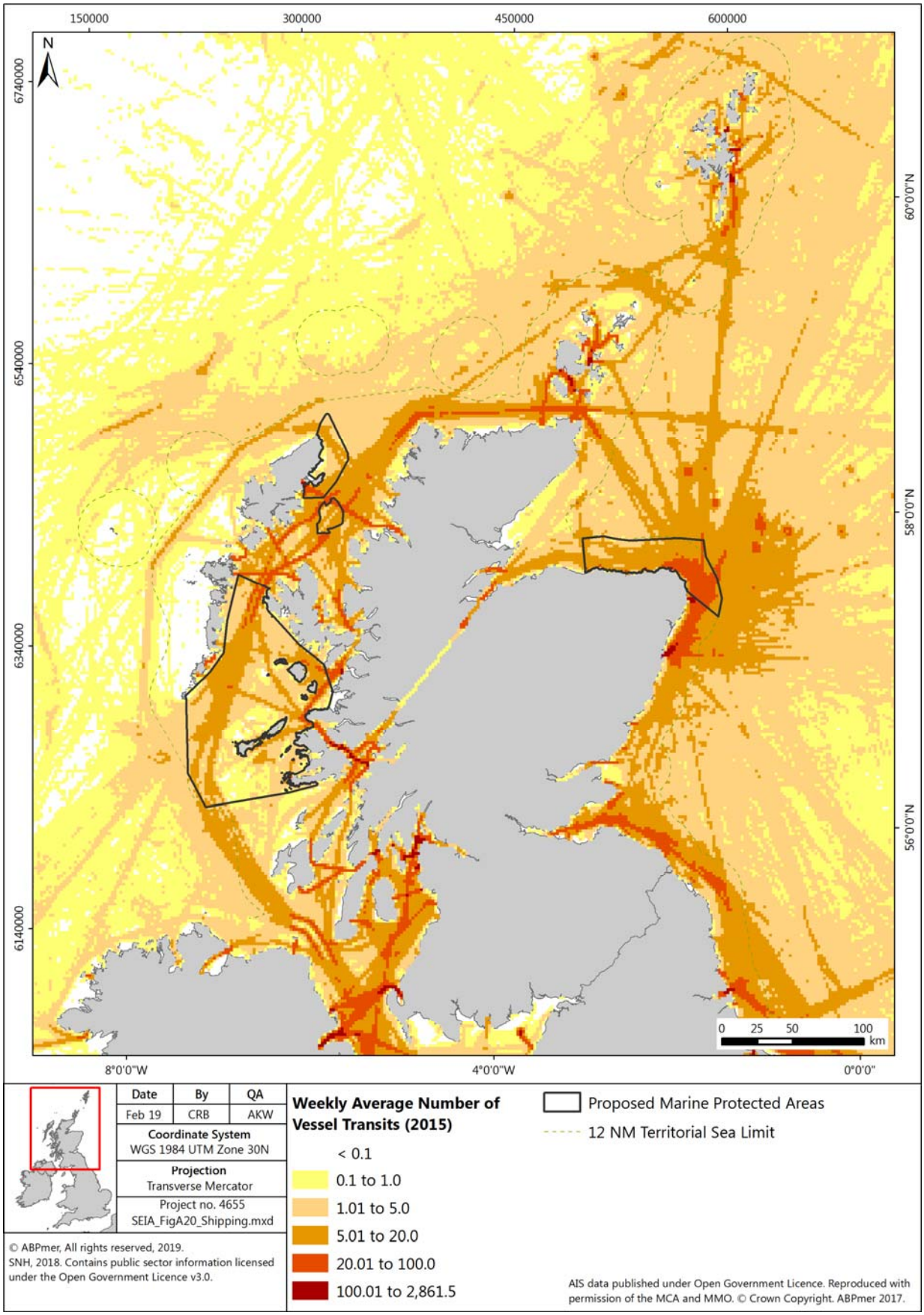


Figure A20 Shipping density in Scottish seas

A.13 Telecommunication Cables

A.13.1 Sector Definition

This sector relates to fibre optic submarine telecommunication cables, which carry telephone calls, internet connections and data as part of national and international data transfer networks utilised for the majority of international communication transmissions.

A.13.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A18.

Table A18 Telecommunications information sources

Scale	Information Available	Date	Source
Scotland	All telecom cables mapping on an interactive map	Current	KIS-ORCA
UK	An economic and social evaluation of the subsea cables	2015	Elliott, *et al.* 2016[199]
UK	Socio-economic importance and trends	2008	Pugh, (2008)[200]

Distribution level and intensity of activity

Telecommunication cables within the Scottish Continental shelf include fibre optic international cable links and domestic inter-island cables which are mainly copper wire. There are 88 active cables in Scottish waters, spanning over 4,000 km of international cables and 600 km of inshore cables[201] (see Figure A21). An international network passes North and South of Shetland connecting Europe to North America, Faroe Islands, Iceland and Greenland, while networks connecting Scotland and Northern Ireland occur in waters off the west and south-west of Scotland. Cables also connect the Scottish mainland and island communities.

In total six cables transect the pMPAs, 2 through SOH pMPA, 2 through STR pMPA and 1 each through NEL and SEB pMPAs.

Economic value and employment

The overall UK telecoms and communications sector has recently been estimated to contribute approximately £45 billion to the economy and employ approximately

[199] Elliott, C., Al-Tabbaa, O., Semeyutin, A. and Tchouamou Njoya, E., 2016. An Economic and Social Evaluation of the UK Subsea Cables Industry. University of Huddersfield. A report commissioned by Subsea Cables UK and The Crown Estate.

[200] Pugh, D. 2008. Socio-economic Indicators of Marine-related Activities in the UK economy. The Crown Estate, 68pp.

[201] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B.and, Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

250,000 people across 8,000 companies[202]. A further preliminary estimate of the economic value of the UK telecommunications subsea cables industry to the digital economy values it at £62.8 billion per annum[203]. Defining the employment of the telecommunication sector within the marine environment alone is difficult given that that much of the sector is related to onshore activity. However, the only known estimate that has been published estimates that about 26,750 jobs in the UK telecommunications sector are marine-related[204].

Future trends

Increasing use of the internet and in e-commerce has led both to an increasing demand for communication cables and for faster services which has meant that the capacity of cables has also grown[205]. According to the European Subsea Cables Association (ESCA) around 97% of international trans-ocean traffic is carried by cable, hence, submarine cables will be vital for the foreseeable future. However, there is little information available on the extent to which new cables will be laid in Scottish waters[206].

Assumptions on Future Activity

It is assumed that future activity is limited to replacing existing telecom cables which were designed with a lifespan of 25 years, but with increasing latency of the cable from increasing consumer demand for data the lifespan may be reduced. It is assumed that 50% of existing telecom cables transecting within 12 nm of the pMPAs will require replacement over the assessment period (assumed to be in 2029).

A.13.3 Potential Interactions with pMPA Features

The burying of telecom cables in the seabed generally involves the use of jetting or a plough, disturbing the local seabed area and producing temporary sediment plumes. Sediment may also be removed from the seabed. The overall level of disturbance to sediments and benthic fauna is, however, likely to be minimal and impacts on pMPA features likely to be short-lived, although recovery rates vary between environments. Sandy and mixed sediment environments, for example, recover more rapidly from disturbance than intertidal sediments supporting biogenic reefs and macrophyte assemblages[207].

[202] Department for International Trade. 2014. Communications industry in the UK: investment opportunities. February 2014. Available at https://www.gov.uk/government/publications/communications-industry-in-the-uk-investment-opportunities/communications-industry-in-the-uk-investment-opportunities.

[203] Elliott, C., Al-Tabbaa, O., Semeyutin, A. and Tchouamou Njoya, E., 2016. An Economic and Social Evaluation of the UK Subsea Cables Industry. University of Huddersfield. A report commissioned by Subsea Cables UK and The Crown Estate.

[204] Pugh, D. 2008. Socio-economic Indicators of Marine-related Activities in the UK economy. The Crown Estate, 68pp

[205] AECOM and ABPmer, 2015. ISLES spatial planning and sustainability appraisal. Irish Scottish links on energy study: ISLES II: Towards implementation.

[206] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B.and, Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[207] JNCC and NE, 2011. General advice on assessing potential impacts of and mitigation for human activities on MCZ features, using existing regulation and legislation. Advice from the Joint Nature Conservation Committee and Natural England to the Regional MCZ Projects. June 2011. 107pp.

Where cable burial is not feasible, mattressing, grout bags or rock dumping may be used. The effects of these techniques may lead to a direct loss of habitat in the surrounding area, particularly where rock dumping may create a hard substrate on originally soft sediment, which may also provide a pathway for invasive non-native species to migrate across an area[208]. During cable installation vessels will need to be anchored, causing abrasion to the local seabed, and underwater noise will also be generated by the presence of vessels.

During cable installation or maintenance activities there is a risk of visual or noise disturbance of fish and marine mammals. There is also some potential for collision risk.

The potential impacts of telecom cable installation and use are likely to be short-term and the impacts on the seabed will remain local. JNCC and Natural England state that in most cases the installation of cables has no significant impact on marine features in an area[209].

A.13.4 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required within 12nm to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Additional assessment for new development proposals affecting MPAs to support marine licence applications;
- Following 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 cables / pipeline routes should avoid northern sea fan and sponge communities (SEB);
- Follow existing best practice mitigation measures / guidance and licensing process for noisy activities;
- No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR);
- No noisy activities during Risso's dolphin high season (May – October) (NEL).

No measures are assessed in relation to the Inner Hebrides Carbonate Production Area (IHCPA), as this feature is being considered through the assessment of management measures for Priority Marine Features (PMFs).

A.13.5 Assessment Methods

The timing and location of telecom cable replacements is uncertain. For the purposes of this assessment, it is assumed that 50% of existing cables will require replacement at

[208] ibid

[209] ibid

some point in the assessment period. For reasons of simplicity, it has been assumed that all replacements will be initiated in 2025 and that the costs for replacement at each site will be halved. While this approach ensures that the national total cost is consistent with the assumptions, for individual sites the costs will be over or underestimated depending on whether cable replacement takes place at those specific sites.

Additional assessment to inform marine licensing

It has been assumed that an additional cost of £5,600 (at 2019 prices) will be incurred to provide information to the regulator concerning the potential impact of replacement telecom cable projects on protected features (based on Marine Scotland (2013)[210] uprated to 2019 prices), as required under the Marine (Scotland) Act 2010. This information would either be reported within the EIA if required, or as a separate MPA assessment. It has been assumed that these assessments are carried out in 2029, and that half of the existing cables are replaced (where there is one cable in a site it is assumed that this cable is replaced, based on the precautionary principle).

Following 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)

Existing best practice is already being followed therefore there is assumed to be no additional cost to this management measure.

New cables / pipeline routes should avoid northern sea fan and sponge communities (SEB)

It has been assumed that cables will be re-routed to avoid sensitive habitats at a cost of £1.15 million per km (uprated to 2019 figures from Annex H14 of Defra, 2012[211]). The potential extra distance has been estimated based on the shortest route avoiding the sensitive feature. It has been assumed that construction is carried out in 2026.

There is one telecom cable within SEB pMPA that intersects northern sea fan and sponge community habitat. It is assumed that this will be replaced half way through the assessment period, and that the required deviation necessitates 0.4 km of additional cabling.

Follow existing best practice mitigation measures / guidance and licensing process regarding noisy activities

Best practice is already being followed, and therefore there is no additional cost associated with this management measure.

[210] 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.

[211] 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

No noisy activities during minke whale and basking shark high season (April – October) (SOH, STR)

It has been assumed that this seasonal restriction can be accommodated without any significant impact on costs.

No noisy activities during Risso's dolphin high season (May – October) (NEL)

It has been assumed that this seasonal restriction can be accommodated without any significant impact on costs.

A.13.6 Limitations

- The number and location of new telecom cables is uncertain; and
- The timing and location of cable replacements is uncertain.

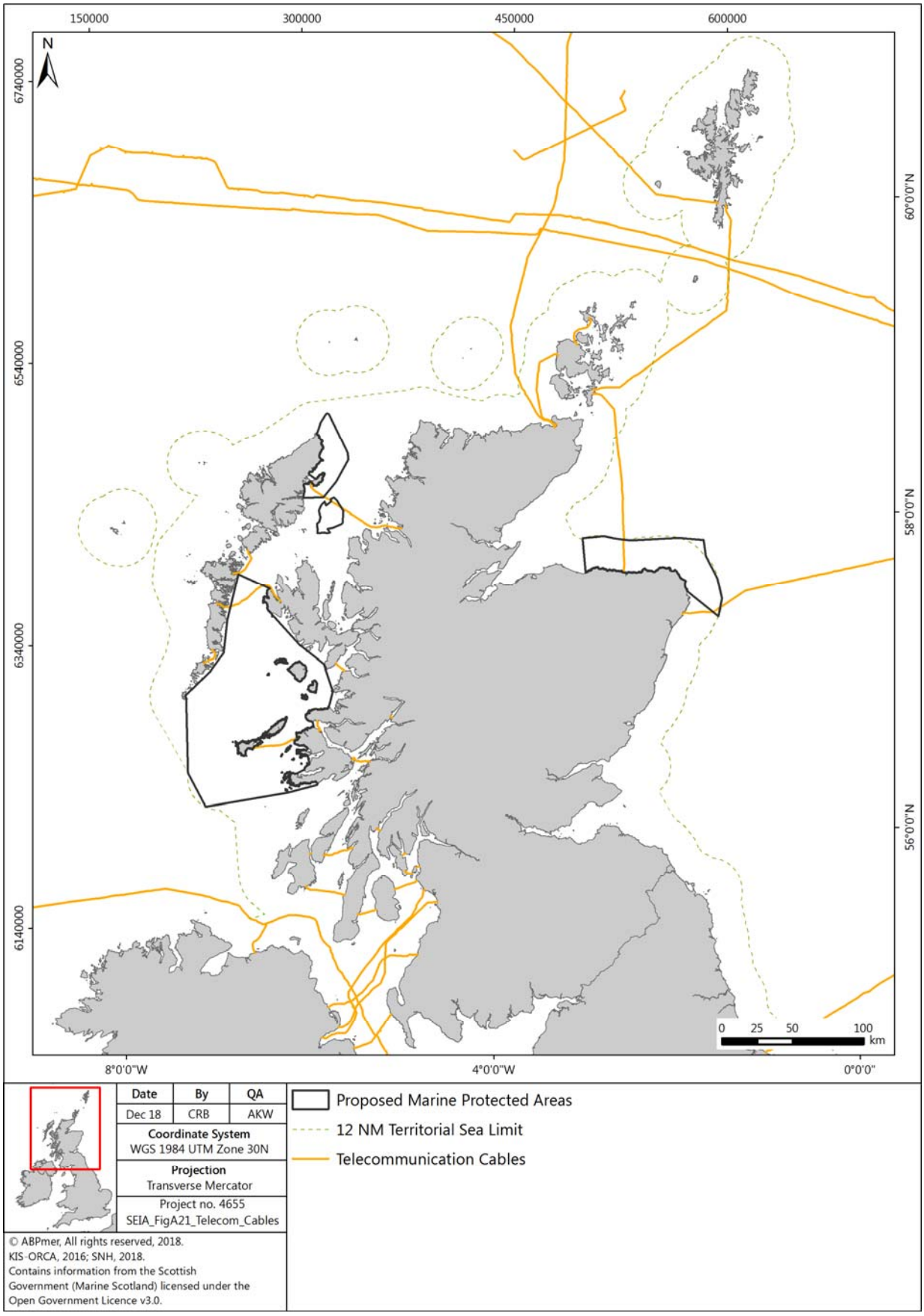


Figure A21 Telecommunication cables in Scottish seas

A.14 Tourism

A.14.1 Sector Definition

Tourism can be defined as 'a stay of one or more nights away from home for holidays, visits to friends or relatives, business/conference trips or any other purposes excluding activities such as boarding education or semi-permanent employment' (VisitScotland). In this baseline, day trips are also included. Marine and coastal tourism can be defined as any recreational activity that makes use of the marine environment and intertidal coastal zones[212]. This can include a range of activities such as walking along the sea-front to sea-side based horse riding. Both non-motorised (walking/picnicking) and motorised (boat-based tourism e.g. wildlife viewing) activities can be included in marine and coastal tourism. Recreational boating and water sports activities are considered as separate sectors (see A.11 and A.15). For this assessment, tourism is defined as relevant activities not already included within recreational boating and water sports, to avoid double counting.

A.14.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A19.

Table A19 Information sources for tourism

Scale	Information Available	Date	Source
Scotland	Economic values for tourism	2013	Scottish Government (2015)
Scotland	Leisure and recreation statistics	2011	Baxter et al. (2011)
Scotland	Visitor numbers by region	2017	Visit Scotland
Scotland	Tourism Scotland 2020 - Tourism industry strategy	2012	Highlands and Islands Enterprise,
Scotland	Tourism employment	2016	Visit Scotland
Scotland	Visitor volume and value http://www.visitscotland.org/pdf/2016_Stats_Summary_v2.pdf	2017	Visit Scotland
Scotland	Expenditure by coastal and marine wildlife visitors in Scotland.	2009	Bournemouth University (2010)
Scotland	Scottish marine recreation and tourism survey http://www.gov.scot/Topics/marine/seamanagement/national/RecandTourism	2015	Land Use Consultants (LUC) for Scottish Government
Scotland	Value of whale watching in West Scotland	2018	Ryan et al.
Scotland	Scotland's Coastal and Maritime Managed Heritage Assets; Visitor Numbers and Revenue	2004-2009	Scotland's National Marine Plan interactive (NMPi)

[212] Benfield, S and McConnell, S, 2007. Marine and Coastal Visitor Management, Public Engagement and Interpretation in Argyll and the Islands: the way forward. Marine and Coastal Development Unit, Argyll & Bute Council, 2007, pp1-145.

Scale	Information Available	Date	Source
Scotland	Economic impact of recreational sea angling in Scotland	2009	Scottish Government
Scotland	Towards a Strategy for Scotland's Marine Historic Environment	2009	Historic Scotland
Scotland	Coastal and marine heritage tourism resources (World Heritage Sites, Designated Wrecks, top wreck dives)	2011	Scotland's NMPi
Scotland	Scotland' National Marine Plan	2014	Marine Scotland (2014)
Scotland	UK Designated protected wreck sites (point)	Current	Scotland's NMPi
Scotland	Protected Wreck Sites (with buffer) (polygon)	Current	Oceanwise, MCA
Scotland	Heritage Coasts (polygon)	Current	Historic Scotland
Scotland	World Heritage Sites (point/polygon)	Current	UNESCO / NMPi
Scotland	Designated Bathing Waters	Current	Scotland's NMPi
Scotland	Blue Flag Beaches (point)	Current	Scotland's NMPi
Scotland	Marine Recreation activity heat maps		Scotland's NMPi

Location of current activity

In 2017, 14.9 million tourism trips were undertaken in Scotland (Visit Scotland, 2018). The Scottish Marine Recreation and Tourism Survey (SMRTS)[213] collated information on recreation and tourism activities undertaken at sea or around the Scottish coast in 2015, including 'general marine and coastal tourism', 'general marine and coastal recreation' and 'walking at the coast (over 2 miles)'.

Scotland's rich cultural and natural heritage provides a range of opportunities for tourism based on local food and drink, sport and recreation, wildlife watching and historic attractions (Marine Scotland, 2014). Overall in 2017, 166 million tourism trips were taken in Scotland[214], although it is not possible to know what proportion of the tourism volume relates to coastal tourism. Visit Scotland[215] reported that 7% of GB holiday visitors to Scotland explored Scottish beaches and 5% watched for wildlife (birds, dolphins, otters etc.) or visited wildlife attractions/nature reserves (the latter activity was not necessarily located at the coast). Scotland's National Marine Plan highlights the Highlands, islands and west coast as some of the key areas for wildlife watching[216].

Figure A22 shows the distribution of tourism activity within Scotland. Although there is a high concentration within the central belt, coastal areas are also well represented with a range of site types present in all regions including the north-east, north-west and

[213] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

[214] Visit Scotland (2017). Scotland's Tourism Performance Summary Report 2017.

[215] VisitScotland, 2014. The Key facts on tourism in 2013.

[216] Marine Scotland, 2014. Scotland's National Marine Plan

north Scotland. Indeed, in these three regions the majority of tourist activity is located on the coast rather than inland.

Types of activity

People undertake a range of activities relating to the marine and coastal environment in Scotland. However, Scotland's Marine Atlas[217] notes that there is not much standardised information on participation in marine-related leisure activities. Individual groups or sectors may gather their own data, for example, surveys estimate that the five most popular marine leisure related activities by participation in the Scotland were[218]:

- Spending general leisure time at the beach: 471,000;
- Coastal walking: 445,000;
- Boating activity: 273,000;
- Outdoor swimming: 233,000; and
- Canoeing: 122,000.

Scottish Natural Heritage (SNH) has also collected data on marine and coastal recreation in Scotland, and has determined that walking/hiking is one of the more popular activities[219].

Economic value and employment

The tourism sector is of vital importance to the Scottish economy. In 2017, overnight visitors to Scotland from the United Kingdom made 14.9 million trips, up from 12.4 million trips in 2010, and spent a total of over £5.2 billion[220], considerably higher than the £2.6 billion spent in 2010[221]. The 2017 figures represented an increase of 4.3% in the number of trips and an 11.3% increase in expenditure when compared with 2016 data[222]. When considering the change in 2016 to 2017 expenditure, much of the increase is derived from international tourism, contributing a 23% increase in spend year-on-year totalling £2.3 billion in 2017. Total overnight and day visitor expenditure in Scotland was around £11 billion in 2017. This comprised expenditure from overnight visitors of £5.3 billion and expenditure by day visitors of £6 billion. Spending by tourists in Scotland generates £10 billion of economic activity in the wider Scottish supply chain and contributes £5 billion to Scottish GDP. This represents just under 5% of total Scottish GDP.

[217] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B., Moffat, C.F., (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[218] Arkenford, (2018). Watersports Participation Survey 2017.

[219] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B. and Moffat, C.F. (Editors), (2011). Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[220] Visit Scotland (2017). Scotland's Tourism Performance Summary Report 2017.

[221] VisitScotland (2011). Domestic Tourism – Review of Domestic Overnight Tourism to Scotland in 2010.

[222] Visit Scotland (2017). Scotland's Tourism Performance Summary Report 2017.

It has been estimated that marine tourism in Scotland generated £544 million GVA in 2016, approximately 14% of the total tourism related GVA in Scotland[223].

In its position statement in response to the Scottish National Marine Plan, Visit Scotland highlighted the major (and growing) importance of 'marine tourism' to national employment and prosperity, and referred to recent studies which estimated that wildlife watching in coastal and marine areas accounted for £163 million in tourist expenditure, and coastal paths, where they exist, attracted over 500,000 visitors per year who made a net expenditure of up to £29 million (actual studies not cited).

Separately it has been estimated that marine and coastal wildlife tourism in Scotland (including cetacean related tourism) has a combined total expenditure of £160 million and total income of £92 million, with peak activity occurring in May and June[224].

The tourism figures above may also provide an indication of the value of some of the benefits from wild land, wilderness and tranquillity. Although McMorran *et al*.[225] note that few studies enable the benefits from wild land to be identified, they comment that recreation and tourism data do provide some information. For example, in the Highlands and Islands Enterprise area, wild landscapes accounted for up to 19.9 million day visits in 2003[226]. These were associated with an expenditure of £411 million to £751 million[227]. It is likely that some of this total can be allocated to coastal tourism and thus the value of seascapes.

Employment in the tourism-related industries sector (as measured by the Scottish Government's Tourism Growth Sector and incorporating both marine and terrestrial based tourism) in Scotland was 217,200 in 2015 – accounting for around 9% of employment in Scotland[228]. Specifically, the Marine Tourism sector is estimated to support 27,900 jobs[229].

Marine and coastal wildlife tourism generated 4,386 full-time positions in 2009. It should be noted that wildlife tourism supports mainly small enterprises, which employ large numbers of seasonal volunteers; 10% use more than 16 volunteers[230].

[223] Scottish Government. 2018. Scotland's Marine Economic Statistics. Available at https://www2.gov.scot/Topics/marine/Publications/TopicSheets/tslist/economy

[224] Scottish Government, 2010. The economic impact of wildlife tourism in Scotland, Scottish Government Social Research, pp1-51.

[225] McMorran R, Price MF, Warren CR. 2008. The call of different wilds: The importance of definition and perception in protecting and managing Scottish wild landscapes. Journal of Environmental Planning and Management 51:177–199.

[226] ibid

[227] ibid

[228] Visit Scotland.2016. Tourism Employment in Scotland.

[229] Scottish Government. 2018. Scotland's Marine Economic Statistics. Available at https://www2.gov.scot/Topics/marine/Publications/TopicSheets/tslist/economy

[230] Scottish Government, 2010. The economic impact of wildlife tourism in Scotland, Scottish Government Social Research, pp1-51.

Future trends in tourism

Tourism within Scotland is supported by Visit Scotland, whose aim is to "maximise the economic benefits of tourism to Scotland". Visit Scotland's strategy has five objectives including:

- Maximise the sustainable economic benefit of tourism in Scotland;
- Inspire through information provision;
- Deliver quality assurance;
- Work in partnership; and
- Establish Scotland as the perfect stage for events.

In 2010 Deloitte[231] presented forecasts for the future contribution of the Visitor Economy to the UK and constituent nations. The study highlighted that the forecasts for each nation are driven by the UK level trends, however, the impact of these trends will differ depending on the nation. For Scotland, the study forecast that the Visitor Economy will contribute £8.5 billion in Value added in 2020, equating to 5.1% of total Scottish GDP (up from 4.9% in 2009). It is projected that in 2020 the Visitor Economy will directly support 157,000 jobs, representing 5.7% of Scottish total employment.

Considering trends in particular areas of tourism, the Scottish Recreation Survey has shown that since 2004, there has been an increase in the number of shorter duration visits made closer to home[232]. In addition, the percentage of visits taken on foot grew from 50% to 64% in 2008[233]. If these trends are to continue, then it is likely that in the future more tourism will occur close to centres of population and at sites which are easily accessible. Indeed, Brown *et al*.[234] note that the most likely trend in future outdoor recreation is that there will be a greater range of activities available, but these will be concentrated in a smaller number of locations, dependent amongst other factors on their accessibility. This suggests that areas which are hotspots for particular activities (e.g. surfing) will be the ones which flourish. However, it should be noted that external factors, such as global climate change may also impact tourism. For example, climate change may affect the distribution and range of cetacean species and thus wildlife watching tourism in Scotland[235].

[231] Deloitte, 2010. The economic contribution of the visitor economy.

[232] TNS Research International, 2011. Scottish Recreation Survey: annual summary report 2010. Scottish Natural Heritage Commissioned Report No.465.

[233] TNS Research International, 2010. Scottish Recreation Survey: annual summary report 2009. Scottish Natural Heritage Commissioned Report No.395.

[234] Brown, K.M., Curry, N., Dilley, R., Taylor, K. & Clark, M., 2010. Assessing future recreation demand. Scottish Natural Heritage Commissioned Report No.404.

[235] Lambert, E., MacLeod, C.D., Hunter, C. and Pierce, G.J., 2011. The Future of Cetacean Watching in Scotland under Different Climate Change Scenarios – The Changing Nature of Scotland, eds. S.J. Marrs, S. Foster, C. Hendrie, E.C. Mackey, D.B.A. Thompson. TSO Scotland, Edinburgh.

A.14.3 Future Trends

It is assumed that the location of tourism activities does not change over the period of the assessment. Levels of tourism activity reflect the economic cycle but are generally expected to increase in the long-term.

A.14.4 Potential Interactions with pMPA Features

Potential interactions of tourism activity with pMPA features are likely to be similar to those of recreational boating and water sports (also see sections A.11 and A.15, respectively).

There are potential impacts to fish and marine mammals associated with vessel movements in relation to collision risk and visual and noise disturbance. There are also risks associated with pollution from fuel, oil and lubricants. The introduction of invasive species into new habitats is also of concern.

Marine wildlife tourism has the potential to interact with pMPA features, principally in the same manner as general vessel movements. Scottish Natural Heritage has produced guidance (The Scottish Marine Wildlife Watching Code) to manage the risk to wildlife, with approximately 67% of respondents in the Marine Recreation and Tourism Survey stating that they were definitely or possibly aware of the code[236].

Increases in tourism can lead to higher footfall on the coastlines, causing potential physical damage to coastal and intertidal areas. The development of facilities to support increases in tourism may lead to increased municipal wastewater discharge, causing potential pollution events which have the potential to impact pMPA features.

A.14.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Follow existing best practice, including SMWWC and WISE scheme.
- Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October (SOH)

A.14.6 Assessment Methods

<u>Follow existing best practice, including SMWWC and WISE scheme</u>

This relates principally to wildlife tour operators who are already following best practice, therefore there is no additional cost associated with this management measure.

[236] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October (SOH)

Given that vessels related to tourism activities are often intending to seek out and view wildlife, it is expected that speeds are unlikely to be considerably more than 6 knots, particularly within the Shark Awareness Zones where the objects of their activities may be encountered, and therefore this management measure will have minimal impact. Where speeds are reduced the zones are sufficiently small not to significantly increase transit times, therefore there is assumed to be no additional cost to tourism activities associated with this management measure.

A.14.7 Limitations

- Uncertainty surrounding impact of reducing speeds to wildlife tour operators.

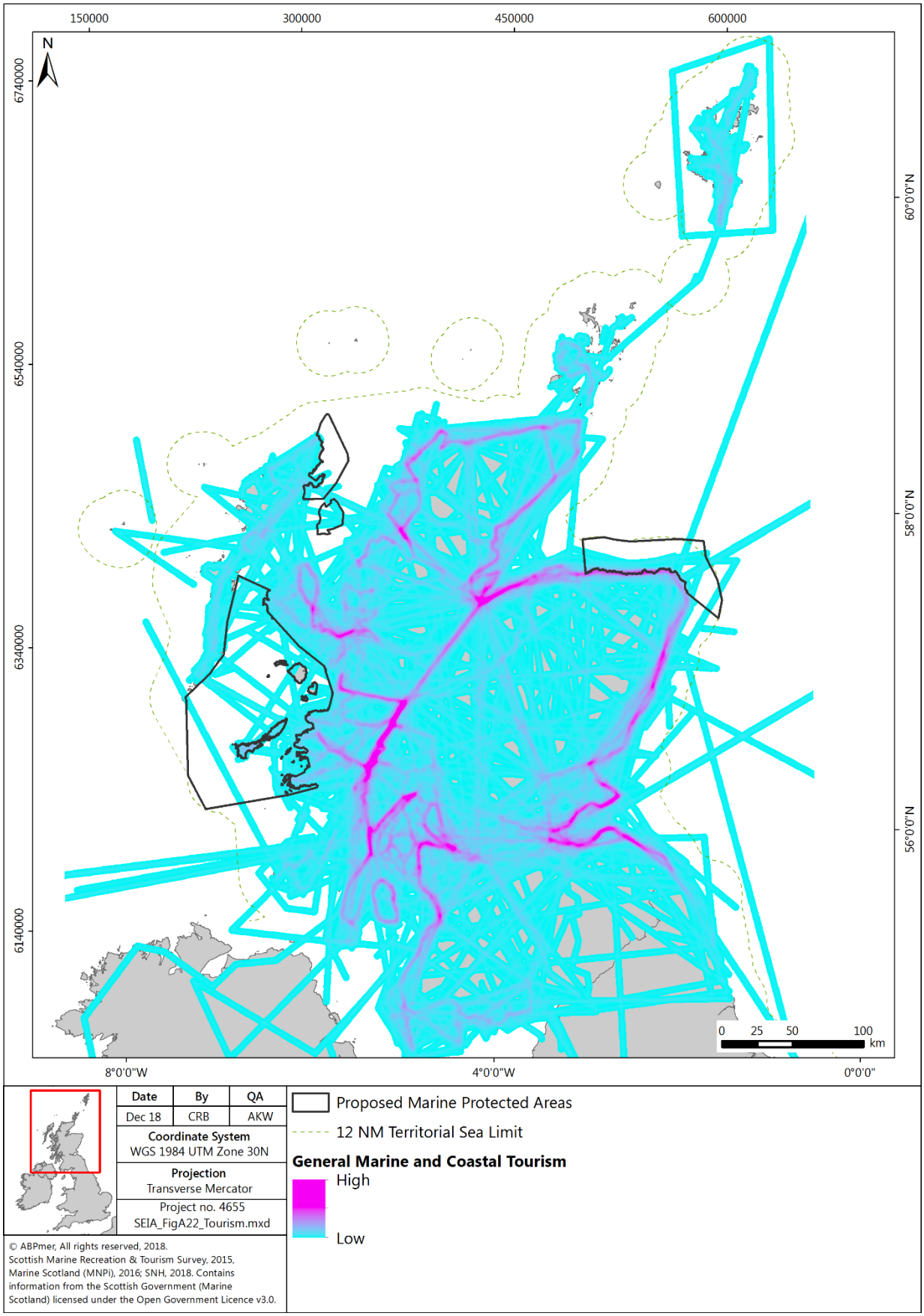


Figure A22 Distribution of general marine and coastal tourism activity in Scotland

A.15 Water Sports

A.15.1 Sector Definition

Water sports are recreational activities undertaken on or immersed in a body of water. The main marine water sports undertaken in Scotland are recreational angling, surfing, windsurfing, sea kayaking, small sail boat activities (such as dinghy sailing) and scuba diving[237]. Recreational boating activity in larger vessels such as yachts is covered separately in Appendix A.11. Tourism is covered in Appendix A.14).

A.15.2 Overview of Existing Activity

A list of sources to inform the writing of this baseline is provided in Table A20.

Table A20 Information sources for water sports

Scale	Information Available	Date	Source
Scotland	Number of sea anglers and sea angling activity	2006-2007	Radford et al. (2009)
Scotland	Economic impact of sea angling (by region)	No date	Radford et al. (2009)
Scotland	Estimated regional sea angling activity and expenditure (also for Scotland)	No date	Baxter et al. (2011)
Scotland	Surfing and diving locations	2011	Scotland's Marine Atlas Ch5
Scotland	Marine Recreation activity heat maps		Scotland's NMPi
Scotland	Marine Recreation and Tourism statistics	2015	LUC, 2016
UK/Scotland	Snorkelling and Diving Locations (not spatial)	Current	www.snorkling.co.uk and www.ukdiving.co.uk
UK/Scotland	Kitesurfing and Windsurfing locations (user-updated)	Current	www.thewindmap.co.uk
UK	Indicative location of coastal watersports centres	2010	Defra/CP2 Scotland's NMPi
UK	Surfing locations	Current	Scotland's NMPi
UK	Economic impact of domestic surfing	2013	SAS
UK	Indicative location of coastal diving areas (Recreational and otherwise)	Current	Scotland's NMPi
UK	Statistics on water sports participation levels	2017	Arkenford (2018)
UK	Location of scuba diving sites	Current	Dive Site Directory www.divesitedirectory.co.uk/uk
UK	Location of windsurf sites	Current	Windsurf Magazine www.windsurf.co.uk/beach-guide

[237] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

Location and intensity of activity

Indicative estimates of the number of people participating in water sports activities in Scotland have been taken from the Water Sports and Leisure Participation Survey 2017[238]. This report estimated that 25,000 adults (over 16 years) participated in surfing, 31,000 adults participated in windsurfing, 23,000 in scuba diving, 121,000 participated in canoeing / kayaking, 129,000 in sea angling and 29,000 in small sail boat activities in Scotland.

From Figure A23, it can be seen that the concentration of coastal recreation activities is highest on the west coast, particularly around the Inner Hebrides and the Firth of Clyde, with some hotspots of activity in the Firth of Forth on the East Coast. In general, activity density reduces as a function of distance offshore, with the highest levels of activity within a short distance of the coastline. A summary of the distribution of different water sports, highlighting key areas activities in Scotland is described below.

A survey looking into marine and coastal recreation in Scotland commissioned by Scottish Natural Heritage found that overall, around 63% of all recorded visits to the coast were day trips. Above average proportions of short-breaks or weekend visits were made by sea and shoreline anglers, and divers and snorkelers[239].

Recreational Angling

Sea angling is carried out along most of the Scottish coastline mostly within 6nm (The Scottish Sea Angling Conservation Network's (SSACN) Offshore Wind SEA consultation response, available on the Scottish Government website). The highest densities of anglers are found in the more heavily populated areas of coast around Glasgow, Clyde, Edinburgh and Fife[240]. Sea angling launch points are also heavily concentrated along the Argyll Coast and Islands, Solway Firth, Firth of Clyde, Firth of Tay, North Coast, and East Grampian Coast[241].

Surfing and Windsurfing

A variety of different types of water craft are used to surf waves including surfboards, body boards, windsurfing boards stand up paddle boards (SUPs) and kayaks (SAS, 2009). Many surfers are willing to travel large distances to undertake surfing at good quality spots[242]. Therefore, high quality waves located in remote areas could bring economic benefits to a rural area through travel, accommodation and subsistence expenditure of visiting surfers. Surfing is focused around the far north coast of Scotland (particularly around Thurso), the north coast from Buckie to Fraserburgh and locations down the east coast including Fife, and from North Berwick to the border. Other

[238] Arkenford, 2018. Watersports Participation Survey 2017.

[239] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

[240] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B. and Moffat, C.F. (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[241] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

[242] Lazarow, N. 2009. Using observed market expenditure to estimate the value of recreational surfing to the Gold Coast, Australia. Journal of Coastal Research, SI 56 (Proceedings of the 10th International Coastal Symposium), 1130-1134.

locations include the Kintyre peninsula, Islay, Tiree, the Western Isles (particularly the west coast of Lewis) and the north coast of Orkney[243] (Baxter et al., 2011).

Sea Kayaking

The majority of sea kayaking is undertaken close inshore, exploring interesting aspects of the coast such as sea caves, inlets and wildlife. Safety issues and a lack of interesting features in general prevent kayaking further offshore. However, open crossings (between two points such as a headland and an offshore island) are regularly undertaken by more experienced sea kayakers. Unlike other water sports activities which are often undertaken in relatively discrete areas (such as a surf spot or diving site), sea kayaking has the potential to be undertaken along much of the Scottish coast and is only constrained by the availability of suitable launching spots such as beaches or slipways. Popular kayaking areas include the Inner Hebrides, East Grampian Coast, Firth of Clyde and Firth of Forth[244]. The Scottish Canoeing Association undertook an online survey of sea kayakers in 2011. The survey had a total of 392 respondents. The survey found that the most popular areas for sea kayaking in Scotland were Arisaig, Knoydart, Sound of Sleat, Argyll Islands, Oban to Fort William and the Clyde.

Scuba Diving

The most popular locations for scuba diving around Scotland are Scapa Flow, Orkney (considered to be one of the best wreck diving areas in the world) and the Voluntary Marine Reserve of St Abbs and Eyemouth off the Berwickshire coastline. Historic Scotland has estimated that around 1,220 records of known shipwrecks and documented losses are located within the pMPA boundaries (Historic Scotland, 2013, pers. comm.).The islands of the Inner Hebrides, the Firth of Forth and coast to the Scottish border, all of the East coast from North of Dundee to the Dornoch Firth are also popular diving destinations[245,246,247,248]. The UK NEAFO, focussing on the recreational use of MPAs, estimated that there are between 462,000 and 772,000 visits to Scottish dive sites annually[249].

Small Sail Boat Activity

Small sail boat activity is defined as dinghies, day boat or other small keelboats, usually taken out of water at the end of use. Small sail boat activity is widespread along the

[243] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

[244] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

[245] ibid

[246] Baxter, J.M., Boyd, I.L., Cox, M., Donald, A.E., Malcolm, S.J., Miles, H., Miller, B. and Moffat, C.F. (Editors), 2011. Scotland's Marine Atlas: Information for the national marine plan. Marine Scotland, Edinburgh.

[247] Scottish Executive, 2007. Scottish Marine Renewables SEA

[248] United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra.gov.uk/

[249] UKNEAFO, 2014 referenced in: New Economics Foundation (NEF), 2014. Recreational Diving in the UK, The Marine Socio-Economics Project, August 2014.

Scottish coast but the Firth of Clyde and Firth of Forth are noted as particularly good places to learn to sail in dinghies[250].

Economic value and employment

It has been estimated that the annual expenditure on marine recreation and tourism activities in Scotland (including but not limited to the activities listed in Table A21) was worth £3.7 billion to the Scottish economy (although acknowledged that this is likely to be an overestimate). Around £2.4 billion of this is associated with general marine recreation and tourism (see Tourism, Appendix A.15) and around £1.3 billion is associated with more specialist activities including wildlife watching (see Tourism) and the marine watersport activities of sailing, kayaking, surfing and angling[251].

Radford *et al*.[252] estimated a total expenditure of £141 million on sea angling in 2008. Sea angling in Scotland also supported 3,148 FTE jobs in 2008, representing an income of £69.7 million[253].

There is limited data concerning the expenditure and employment levels of surfing related tourism[254]. At a UK level the economic value of the surf industry was estimated at £200 million in 2007[255]. The total number of people participating in surfing in the UK in 2009 was estimated to be 650,000[256]. If it is assumed that the Scottish value is pro rata to the estimated number of individuals engaging in surfing activity in Scotland, this would give a Scottish value of around £16.4 million per year.

'Informed opinion suggests that sea kayaking, particularly on the west coast, and surf kayaking could be worth an estimated £0.5 million per annum' based on a study carried out by British Waterways and reported in Bryden *et al*.[257], in which average paddlers in the Great Glen (2,500 per annum) spent approx. £97 per day locally on overnight visits, or approximately £730,000 per annum.

A survey commissioned by SNH reviewing marine and coastal recreation in Scotland identified the amount typically spent per year on equipment for water sports activities (Table A21). The highest average amounts spent were for sea angling (£1,375) and shore angling (£860). Kayaking and canoeing, sub-aqua and snorkelling, and windsurfing each had an average spend of between £635 and £645, whilst surfing had a lower average spend of £290 per year. In total, sea angling and shore angling accounted for around half of the total spending recorded by the survey. However due to

[250] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

[251] ibid

[252] Radford, A., Riddington, G. and Gibson, H., 2009. Economic Impact of Recreational Sea Angling in Scotland. Prepared for the Scottish Government. July 2009. ISBN: 978-0-7559-8130-4

[253] ibid

[254] Surfers Against Sewage (SAS), 2009. Guidance on environmental impact assessment of offshore renewable energy development on surfing resources and recreation.

[255] United Kingdom Marine Monitoring and Assessment Strategy (UKMMAS), 2010. Charting Progress 2 Feeder Report Productive Seas. Department for Environment Food and Rural Affairs on behalf of UKMMAS (Eds. Saunders, J. and McKie, J.) 472pp Available online: http://chartingprogress.defra.gov.uk/

[256] Arkenford, 2018. Watersports Participation Survey 2017.

[257] Bryden, D.M., Westbrook, S.R., Burns, B., Taylor, W.A., and Anderson, S. 2010. Assessing the economic impacts of nature based tourism in Scotland Scottish Natural Heritage Commissioned Report No. 398.

the small sample sizes these results are subject to high levels of uncertainty and it should be noted that these figures are generally overestimates[258].

Table A21 Total and average annual spending, by water sport activity

Activity	Total annual trip based spending (£)	Median annual spending (£)
Sea angling	105,862,470	660
Shoreline angling	51,930,216	300
Canoeing / kayaking	16,697,121	250
Sub aqua/ snorkelling	13,429,376	400
Windsurfing	1,919,419	635 (2007 value)
Surfing / surf kayaking / paddleboarding	6,666,199	500

(Source: Land Use Consultants, 2016[259])

No national employment figures derived from the Business Register and Employment Survey (using UK SIC codes) have been included for activities relating to water sports. This is because the codes are for the entire sports sector and do not permit disaggregation to a useful level. However, in general the largest numbers of employees for these activities are concentrated in the East and West Regions, which reflect the higher population concentrations in these regions.

Future trends

The leisure and recreation sector has experienced large growth in a number of diverse areas over the past decade. The growth and stability of the water sports sector in Scotland is heavily dependent on the general health of the UK economy. A strong economy means that consumers have more disposable income and are more inclined to spend money on this sector than when the economy is weaker. The UK economic downturn has led to a reduction in such activities but in the long-term the sector is expected to continue to grow.

There is little information on future levels of recreational angling activity. Levels of activity are likely to vary in response to trends in the overall economy, changes in fish stocks as a result of improved fisheries management and changes in fish distributions in response to climate change. The nature and direction of these changes remains unclear.

A.15.3 Assumptions on Future Activity

It is assumed that the locations of water sports activities do not change over the period of the assessment. Levels of participation in water sports activities reflect the economic cycle but are generally expected to increase in the long-term. However, for the purposes of this assessment, in the absence of reliable forecasts on future growth, it

[258] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

[259] LUC (2016). Scottish Marine Recreation and Tourism Survey, 2015. Prepared for Marine Scotland, March 2016.

has been assumed that levels of participation remain constant over the period of the assessment.

A.15.4 Potential Interactions with pMPA Features

Water sports activities have the potential to cause visual and/or noise disturbance to fish and marine mammals. There is also some potential for the removal of species or physical damage through trampling or disturbance. The introduction and spread of invasive non-native species may also be associated with water sports.

Where watersports activities involve vessel use (principally diving and sea angling) there is potential for collision risk with marine mammals and basking sharks.

A.15.5 Potential Management Scenarios

The following management scenarios have been identified by Marine Scotland as potentially being required to support the achievement of conservation objectives in specific pMPAs (see Appendix D: Management Scenarios):

- Follow existing best practice, including SMWWC and WISE scheme.
- Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October (SOH)

A.15.6 Assessment Methods

Follow existing best practice, including SMWWC and WISE scheme

This relates principally to scuba diving and sea angling operators who are already following best practice, therefore there is no additional cost associated with this management measure.

Vessel speeds restricted to <6 knots within the Shark Awareness Zones between June and October (SOH)

For watersports vessels whose activities are intended to seek out wildlife (e.g. scuba diving and sea angling), it is expected that speeds are unlikely to be considerably more than 6 knots, and therefore this management measure will have minimal impact. For vessels that travel faster (e.g. powerboating and motor cruising), the speed restriction will increase the transit time through the Shark Awareness Zones, but travelling at lower speeds also reduces fuel consumption and will reduce fuel costs. It is therefore assumed that there is no additional cost to water sports activities associated with this management measure.

A.15.7 Limitations

- Participation rates and location of future water sports activities are uncertain.

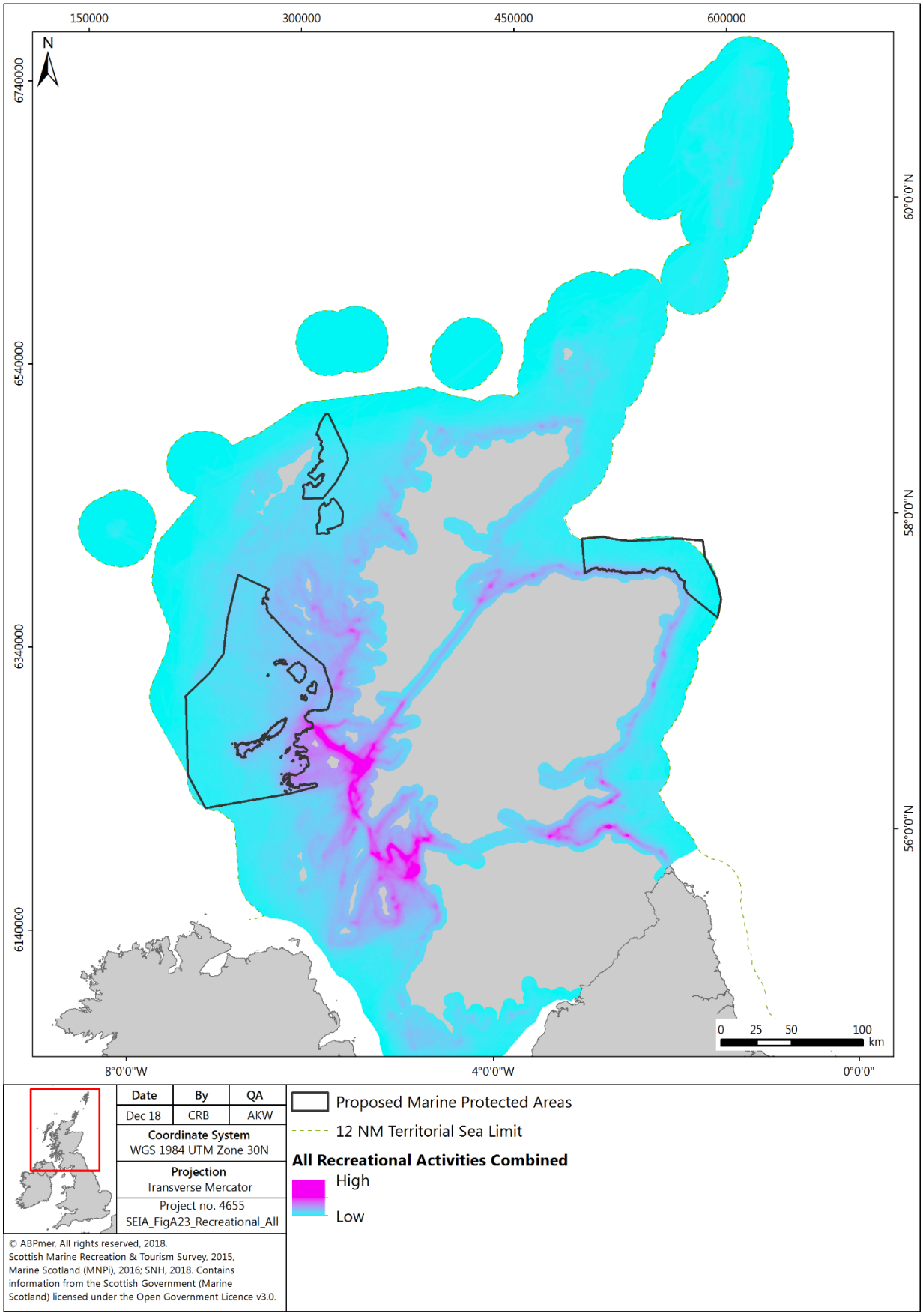


Figure A23 Density of marine recreation activities around Scotland