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Pentland Firth and Orkney Waters Enabling Actions Report

A Socio-economic Methodology and Baseline for Pentland Firth and Orkney Waters Wave and Tidal Developments

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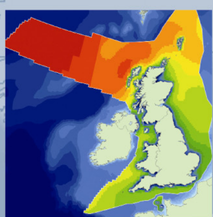
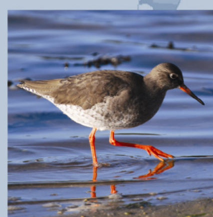
Report R.1826

May 2012

Creating sustainable solutions for the marine environment

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Summary

ABP Marine Environmental Research Ltd, (ABPmer) and Risk & Policy Analysts (RPA) were commissioned by The Crown Estate (TCE) in June 2011 to develop a common approach and associated methodologies that could be used to assess the potential socio-economic impacts (both positive and negative) of Pentland Firth and Orkney Waters (PFOW) wave and tidal developments.

This report identifies the potential positive and negative socio-economic impacts from the PFOW projects and presents a common approach with associated methodologies that can be adopted by developers in carrying out the socio-economic aspects of their Environmental Impact Assessments (EIAs). This includes assessments both in relation to individual projects and in terms of cumulative effects associated with other projects.

Existing data sources are identified, and a baseline provided. A gap analysis, which highlights where developers might need to collect additional data, is also presented. It is recommended that the methodologies for assessing GVA and employment benefits associated with supply chains are further developed and tested prior to application. It may also be appropriate to pre-complete some of the cumulative assessments to assist developers with their project-specific assessments,

Acknowledgements

We are grateful for advice and comments from the Steering Group: Professor Mike Cowling (TCE), John Robertson (TCE), Norma Hogan (HIE) Ewan Sneddon (Sneddon Economics on behalf of HIE), Pippa Goldschmidt (Marine Scotland) and (Joe Kidd (Marine Current Turbines on behalf of the PFOW Developers Forum) and also from wider members of the PFOW Developers Forum.

We are also grateful to Marine Scotland for the provision of fisheries landings data, over-flight data and VMS data.

Abbreviations

£	Pound(s) Sterling
ABI	Association of British Insurers
ABPmer	ABP Marine Environmental Research Ltd
ACT	Air Combat Training
AIS	Automatic Information System
ASP	Association of Surfing Professionals
AST	Appraisal Summary Table
BMF	British Marine Federation
bn	Billion
BT	British Telecom
BVG	BVG Associates
CBA	Cost-Benefit Analysis
CCGT	Combined Cycle Gas Turbine
Cefas	Centre for the Environment, Fisheries and Aquaculture Science
CFP	Common Fisheries Policy
CPUE	Catch Per Unit Effort
Defra	Department of the Environment, Food & Rural Affairs
DEU	Germany
DfT	Department for Transport
DNK	Denmark
DREAM®	Detailed Regional Economic Accounting Model
EC	European Commission
EEC	European Economic Community
EIA	Environmental Impact Assessment
EMEC	European Marine Energy Centre
ESP	Spain
EU	European Union
FRA	France
FRO	Faeroe Islands
FTE	Full Time Equivalent
GBR	Great Britain
GCU	Glasgow Caledonian University
GDP	Gross Domestic Product
GT	Gross Tonnes
GVA	Gross Value Added
H&I	Highlands & Islands
HIE	Highlands & Islands Enterprise
HRA	Habitats Regulations Appraisal
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICES	International Council for the Exploration of the Seas
ICZM	Integrated Coastal Zone Management
IO	Input/Output
IRL	Ireland
ITV	Independent Television
KIS-CA	Kingfisher Information Service - Cable Awareness

km	Kilometre(s)
KW	Kilowatt(s)
kwdays	kilowatt days
LAT	Lowest Astronomical Tide
LVIA	Landscape and Visual Impact Assessment
MCA	Maritime and Coastguard Agency
MCCIP	Marine Climate Change Impacts Project
MEDIN	Marine Environmental Data and Information Network
MPA	Marine Protected Areas
MRCC	Maritime Rescue Coordination Centre
MRPF	Marine Renewables Proving Fund
MSP	Marine Spatial Planning
MT	Million Tonnes
MW	Megawatt(s)
n.e.c.	Not elsewhere classified
n/a	Not applicable
NATS	National Air Traffic Services
Nd	Not determined
NLD	Netherlands
NOMIS	Web-based database of labour market statistics
NOR	Norway
NUTS	Nomenclature of Territorial Units for Statistics
NPV	Net Present Value
NRA	Navigation Risk Assessment
NRIP	National Renewables Infrastructure Plan
ONS	Office for National Statistics
OREF	Orkney Hydrodynamic Research Facility
OSGB	Ordnance Survey Great Britain
OWF	Offshore Wind Farm
PFOW	Pentland Firth and Orkney Waters
RACON	RAdar and beaCON
RLG	Regional Locational Guidance
ro-ro	roll-on roll-off
RPA	Risk & Policy Analysts Limited
RSPB	Royal Society for the Protection of Birds
RUS	Russia
RYA	Royal Yachting Association
SAM	Social Accounting Matrix
SAS	Surfers Against Sewage
SDI	Scottish Development International
SE	Scottish Enterprise
SEA	Strategic Environmental Assessment
SIC	Standard Industrial Classification
SIMA	Surf Industry Manufacturers Association
SIMD	Scottish Index of Multiple Deprivation
SNH	Scottish Natural Heritage
SPP	Scottish Planning Policy

SQW	SQW Limited
TCE	The Crown Estate
UHI	University of Highlands and Islands
UK	United Kingdom
UKCPC	UK Cable Protection Committee
UKDEAL	UK Digital Energy &. Atlas Library
UKMMAS	UK Marine Monitoring and Assessment Strategy
UNIV	University
USA	United States of America
VMS	Vessel Monitoring System
vs	Versus
VTS	Vessel Traffic Services
WAG	Welsh Assembly Government
WQS	Water Quality Standard

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1. Introduction

1.1 Background

In 2010, The Crown Estate (TCE) entered into leasing agreements for 11 wave and tidal stream energy developments in Pentland Firth and Orkney Waters (PFOW) with a potential installed capacity of 1,600MW (Figure 1). The first installed project is due to be operational during 2014, with installation peaking in 2019 (Figure 2).

TCE is working with the PFOW Developers Forum to take forward a number of enabling actions to support delivery of the PFOW projects. ABP Marine Environmental Research Ltd (ABPmer) and Risk & Policy Analysts Ltd (RPA) were appointed by TCE in June 2011 to develop a methodology for undertaking socio-economic assessments for PFOW developments and to collate existing baseline information.

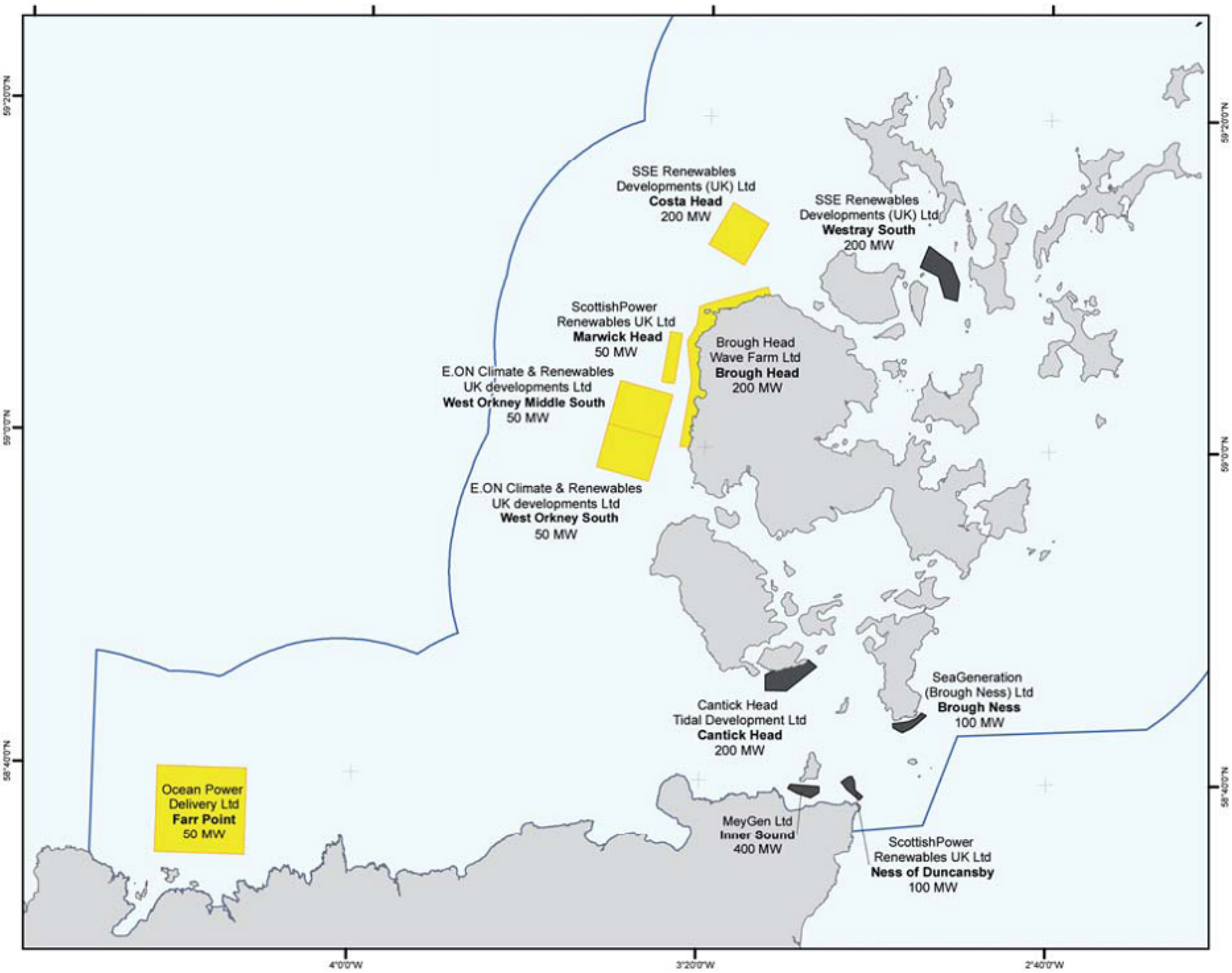
The wave and tidal projects are likely to have varied socio-economic impacts during the course of their development, operation and eventual decommissioning. Positive impacts on Gross Value Added[1] (GVA) and employment will arise from the anticipated £6bn investment in wave and tidal development and associated benefits to supply chains. The developments also have the potential to give rise to negative socio-economic impacts as a result of interactions with some existing sea users and interests.

The EIA Directive (85/337/EEC as amended) requires a description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors. While there is limited guidance on the precise requirements in relation to factors such as population and other material assets, it is generally accepted practice that EIAs should seek to demonstrate the socio-economic benefits and consider potential impacts to existing assets and users. The concept of economic benefit as a material consideration is confirmed in Scottish Planning Policy 6 (SPP6).

While existing Environmental Impact Assessment (EIA) procedures require decision makers to balance the need for a development against its environmental impact when considering whether to grant consent, there has generally been no clear guidance on how such assessments should be carried out, nor on the information requirements to support such decisions. Increasingly, decision makers are recognising the importance of the need to consider environmental, economic and social issues in an integrated manner when assessing development proposals and such approaches are strongly supported in policy, for example, within the UK Marine Policy Statement.

All of the consenting applications will be considered by Marine Scotland. There is therefore advantage in the adoption of common socio-economic methodologies amongst the PFOW projects to support efficiency of analysis, preparation of consent applications and the assessment of those applications by the regulator.

1 A measure of the increase in value of goods and services produced by an activity.

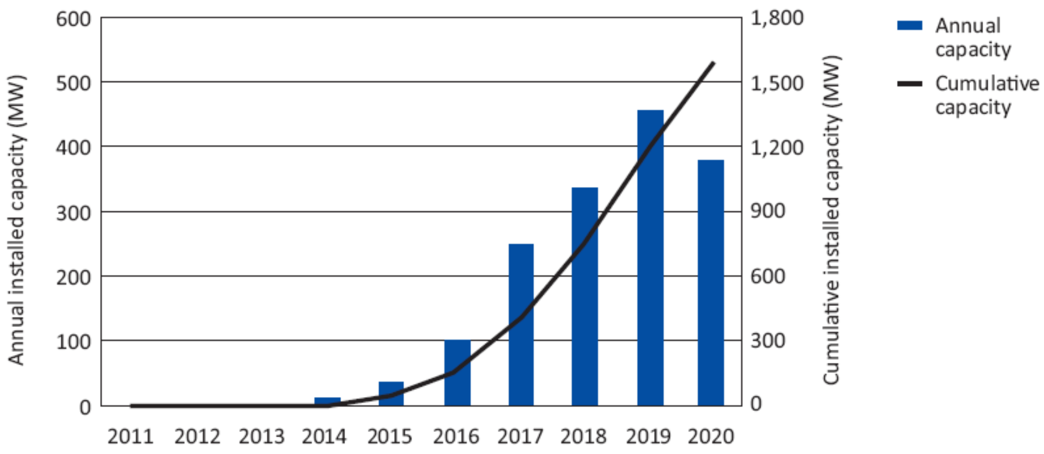


Key:

Site		Developer (Technology) (Owners(s) of Tenant)	Capacity (MW)
Wave	Costa Head	SSE Renewables Developments Ltd	200
	Brough Head	Aquamarine Power Ltd and SSE Renewables Developments Ltd (Oyster)	200
	Marwick Head	Scottish Power Renewables UK Ltd	50
	West Orkney South	E.ON Climate and Renewables UK Developments Ltd	50
	West Orkney Middle South	E.ON Climate and Renewables UK Developments Ltd	50
	Farr Point	Pelamis Wave Power Ltd (Pelamis)	50
Tidal	Westray South	SSE Renewables Developments Ltd	200
	Cantick Head	SSE Renewables Holdings (UK) Ltd and OpenHydro Site Development Ltd (OpenHydro)	200
	Brough Ness	Marine Current Turbines Ltd	100
	Inner Sound	MeyGen Ltd	400
	Ness of Duncansby	Scottish Power Renewables UK Ltd	100

(Courtesy of: The Crown Estate, 2011)

Figure 1. Location of Pentland Firth Wave and Tidal Lease Areas



(From: BVG Associates, 2011)

Figure 2. Indicative Installation Plan for PFOW Developments

This study has therefore sought to:

- Develop a common approach and associated methodologies to be adopted by each of the project developers when conducting socio-economic work as part of the EIAs, including both project-level and cumulative assessment, with input from development companies, regulators and other stakeholders; and
- Prepare a socio-economic baseline from available data on which developers can draw;
- Identify key data gaps and make recommendations on how these might be filled;
- Make recommendations on those parts of the socio-economic analysis which can be pre-completed.

1.2 Methodology

The study has been overseen by a small Steering Group comprising TCE, Highlands & Islands Enterprise (HIE), Marine Scotland and Marine Current Turbines (on behalf of the Developers Forum). A full list of stakeholder organisations contacted through the study is provided at Appendix A.

The methodology for the study comprised:

- Scoping of potential socio-economic impacts associated with PFOW projects (Section 2):
  - Identification of activities associated with PFOW projects that might contribute to employment and GVA;
  - Identification of other potential benefits of PFOW projects;
  - Identification of potential interactions between wave and tidal developments and marine users and other interests (excluding interests where there is not expected to be any interaction/impact);

- Compiling socio-economic baseline information for elements scoped in to the assessment (see Appendix B);
- Identification of suitable socio-economic assessment methodologies (Section 3 and Appendix C);
- Preparation of a gap analysis based on information requirements to apply methodologies (Section 4); and
- Developing recommendations on a common approach to assessing socio-economic impacts, and provision of appropriate supporting methodologies for assessing specific impacts for each sector/interest (Section 5).

2. Scoping Potential Socio-economic Impacts

The potential socio-economic impacts were identified through analysis of (i) potential investment benefits from the supply chain; and (ii) identification of potential interactions between the developments and marine users and other interests. This allows certain sectors and interests, where interactions are not expected to occur, to be excluded from (scoped out of) the study.

2.1 Investment Benefits

BVG Associates (2011) identified a total investment of around £6bn for PFOW projects. This scale of development clearly has the potential for significant positive socio-economic impact both in terms of national, regional and local expenditure in supply chains (measured as GVA) and increased employment. The BVG report identifies a number of key activities associated with PFOW projects which have the potential to contribute to GVA and employment:

- Development and consenting;
- Device manufacturing;
- Balance of plant manufacture;
- Installation and commissioning; and
- Operation and maintenance.

The scale of the benefits within the PFOW area will be heavily dependent on the amount of expenditure that is realised locally. The National Renewables Infrastructure Plan (NRIP) Phase 2 Report (SE & HIE, 2010) identifies various port locations within the PFOW Region that could support wave and tidal development including Scrabster, Lyness, Kirkwall Pier, and Hatston Pier as potential fabrication and supply bases, together with a number of additional local support and supply bases. Outside the PFOW Region, a large number of existing port locations have been identified in Scotland as potentially providing sites for fabrication and/or supply either using existing facilities or through the provision of new facilities (SE & HIE, 2010).

In addition to GVA and employment benefits, a wide range of other benefits could be realised as a result of PFOW investment including:

- Reduced carbon emissions;
- Improvements to existing infrastructure;
- Increased knowledge as a result of research and development in wave and tidal technologies and from environmental surveys;
- Supply chain development/clustering increasing the UK's ability to service future domestic and international demand; and
- Improvements to energy security (depending on the mix of electricity generation displaced).

2.2 Potential Interactions with Marine Users and Other Interests

A number of studies have considered the potential interactions between wave and tidal development and marine users and other interests (including interests on land) which may give rise to socio-economic impacts (e.g. Scottish Executive 2007; Marine Scotland, 2011) and similar studies have also been carried out for Scottish offshore wind farm development (ABPmer *et al*, 2011).

The interactions may potentially result in both positive and negative impacts. Particularly for those sectors that form part of the PFOW supply chain, such as engineering businesses, shipping, and ports & harbours, there is significant potential for benefits to arise as a result of investment in the supply chain. Sectors such as tourism may also benefit from increased occupancy of hotels and improved flight schedules. Similarly, some of the social impacts, such as impacts on employment, will also be positive as a result of this investment. These benefits can be captured as part of the assessment of investment benefits.

While there is some potential for positive socio-economic impacts to arise for other sectors and interests, such benefits may be more limited, as they are not a specifically targeted outcome of investment. For example, the presence of wave and tidal stream developments may be incorporated within a wider ecotourism experience, but this is only likely to provide a significant benefit if it is accompanied by the development of visitor information boards or visitor centres.

Negative socio-economic impacts may be experienced by some marine users and other interests, which could include commercial fisheries, shipping, ports & harbours, tourism, recreational boating, water sports, telecom and power cables and social interests.

Table 1 presents a summary of the potential interactions (both positive and negative) that might occur based on previous studies and the experience of the study team. Potentially significant interactions within the PFOW area have then been identified taking account of the location of activities within the area.

Those sectors/interests where no significant interactions are expected to occur are identified in Table 1, and have been scoped out of the requirement for more detailed socio-economic assessment on these grounds — including aquaculture, aviation and other forms of renewable energy. Similarly, military interests are largely confined to an Air Combat Training (ACT) area, for which there should be no significant interaction with wave and tidal developments.

Table 1. Potential Interactions Between PFOW Projects and Other Marine Uses and Interests

Sector/Interest	Nature of Potential Interaction	Sector/Interest Present in PFOW Area (✓/×)	Scoped in to Study (✓/×)	Comments
Aquaculture	▪ Competition for space ▪ Impacts to water quality or underwater noise during construction	✓	×	No existing fish farms or shellfish aquaculture sites within 3km of any development site; future aquaculture development unlikely to seek to locate in tidal stream or wave deployment areas; water quality and underwater noise impacts will be managed through the EIA process.
Commercial Fisheries	▪ Displacement of fishing effort ▪ Impacts to fish resources ▪ Diversion of fishing vessels ▪ Spillover benefits from *de facto* closed areas ▪ Reduction in landings available to fish processors	✓	✓	A number of locally important fisheries occur in the development area
Commercial Shipping	▪ Displacement of shipping routes ▪ Additional navigation hazard ▪ Supply chain opportunities	✓	✓	A number of commercial shipping routes traverse the development area
Ports & Harbours	▪ Disruption to or loss of trade ▪ Disruption to or loss of dredge material disposal sites ▪ Supply chain opportunities	✓	✓	Several commercial ports lie within the development area. Gills Bay disposal site (closed) lies within Inner Sound tidal site; Stromness A disposal site lies 500m inshore of West Orkney South wave site
Aviation	▪ Interference with radar systems	✓	×	NATS have confirmed that there are no significant issues for wave and tidal devices in the development area.
Military Activities	▪ Displacement of activity ▪ Interference with underwater communications	✓	×	An Air Combat Training area overlaps the development area, but no danger areas or bye-lawed areas are present.
Renewable Energy (e.g. OWF)	▪ Competition for space	×	×	No short-term or medium term options for OWF development lie within or adjacent to the development area
Tourism (inc ecotourism, archaeological heritage)	▪ Increased hotel occupancy rates ▪ Improved travel connections ▪ Impacts to tourism assets ▪ Loss of amenity ▪ Ecotourism development opportunity	✓	✓	Tourism is very important to the regional and local economy.
Recreational Boating	▪ Diversion of recreational vessels ▪ Additional navigation hazard	✓	✓	A number of cruising and sailing routes traverse the development area
Water sports including recreational angling, surfing, windsurfing, kayaking and diving	▪ Displacement of activity ▪ Impacts to resources ▪ Loss of amenity	✓	✓	The development area supports a number of important water sports activities
Cables & Pipelines	▪ Competition for space ▪ Increased maintenance ▪ Supply chain opportunities	✓	✓	Northern Lights cable traverses West Orkney South, West Orkney Middle South and Brough Head sites; Power cable between Rousay and Westray traverses Westray South site.
Social Impacts	▪ Employment impacts ▪ Infrastructure impacts (transport, schools, health services) ▪ Housing impacts ▪ Impacts on landscape/seascape ▪ Impacts on way of life	✓	✓	Scale of development has the potential to give rise to significant impacts at a local level.

3. Recommended Common Approach to Assessing Potential Socio-economic Impacts

Detailed suggestions for assessing the potential socio-economic impacts of PFOW projects are presented in Appendix C. This includes recommendations as to whether the assessments should be undertaken at individual project level, cumulative level (all PFOW projects) or both. In considering cumulative effects the study has only considered the cumulative effects of PFOW projects and has not taken account of other potential developments in the PFOW region. In undertaking assessments of socio-economic impacts, PFOW developers may need to consider the potential cumulative effects of PFOW projects together with other extant development proposals in the PFOW region, although the cumulative investment in PFOW projects is likely to be by far the largest investment over this time scale. A summary of the recommended approach is provided in Figure 3.

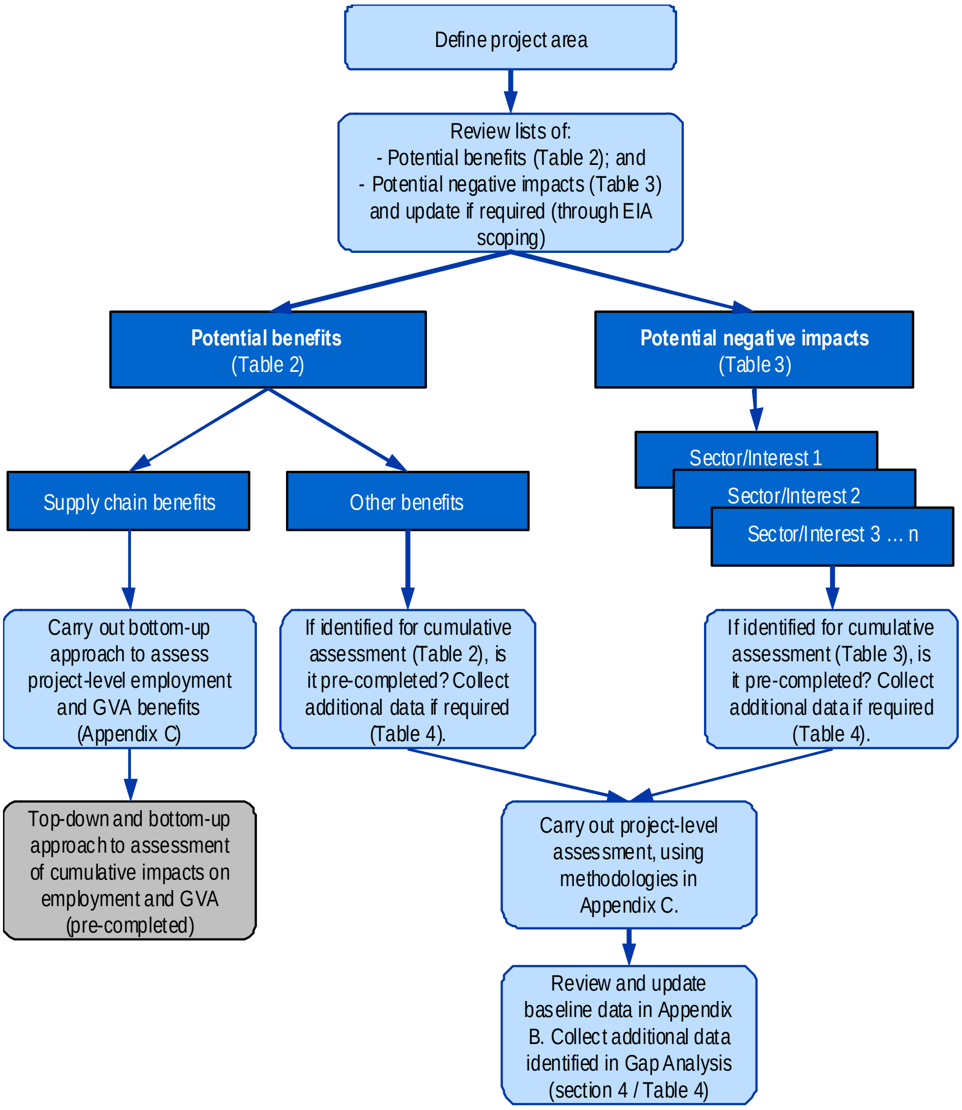


Figure 3. Recommended Common Approach to Assessing Socio-economic Impacts

3.1 Assessing Benefits

Table 2 summarises the suggested methodologies for evaluating potential benefits from PFOW projects.

Table 2. Suggested Approaches to Assessing Potential Benefits

Benefit	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Supply Chain	Increased employment and GVA	Estimated number of jobs created/sustained and estimated increase in GVA from expenditure (value and location)	✓ Bottom-up methodology	✓ Bottom-up and top-down methodology
Carbon emissions avoided	Carbon savings	Gross carbon savings compared to a standard baseline	✓	✓
Improvements to existing infrastructure, facilities and services e.g. airport facilities, flights, port facilities, hotel facilities etc	Increased employment and GVA, increased investor confidence, increased potential for economic growth	Qualitative identification of relevant benefits	✓	✗
Benefits to other marine users and interests e.g. increased hotel occupancy, improved facilities for marine users	Increased employment and GVA; increased investor confidence, increased potential for economic growth	Only consider where supporting actions being implemented	(✓)	✗
Social benefits	Increased employment, education and skills, quality of life	Jobs created/sustained (see Supply chain above); qualitative assessment of changes in education/skills and quality of life	✓	✓
Increased knowledge as a result of research and development in wave and tidal technologies and from environmental surveys	Increased investor confidence; increased potential for economic growth and export opportunities	Qualitative description of benefits	✓	✗
Supply chain development/clustering increasing the UK's ability to service future domestic and international demand	Increased investor confidence; clustering significantly increases potential for economic growth and export opportunities	Qualitative description of benefits	✓	✗
Improvements to energy security	Increased domestic supply and economic resilience	Qualitative description of benefits	✓	✗

The quantification of supply chain benefits is particularly challenging owing to the issues associated with estimating the spatial distribution of expenditure and the extent of leakage of expenditure from the PFOW area and wider Scotland.

To assess employment and GVA benefits associated with individual projects, it is recommended that a bottom-up approach is used which takes account of information on the type and timing of supply chain expenditure. In order to develop this method further, it is recommended that it is trialled with two of the PFOW developers that are at a relatively advanced stage of planning before being applied more widely.

To assess cumulative effects, it is recommended that both bottom-up and top-down approaches are applied in order to seek to address methodological weaknesses in the individual methods (see Figure 4).

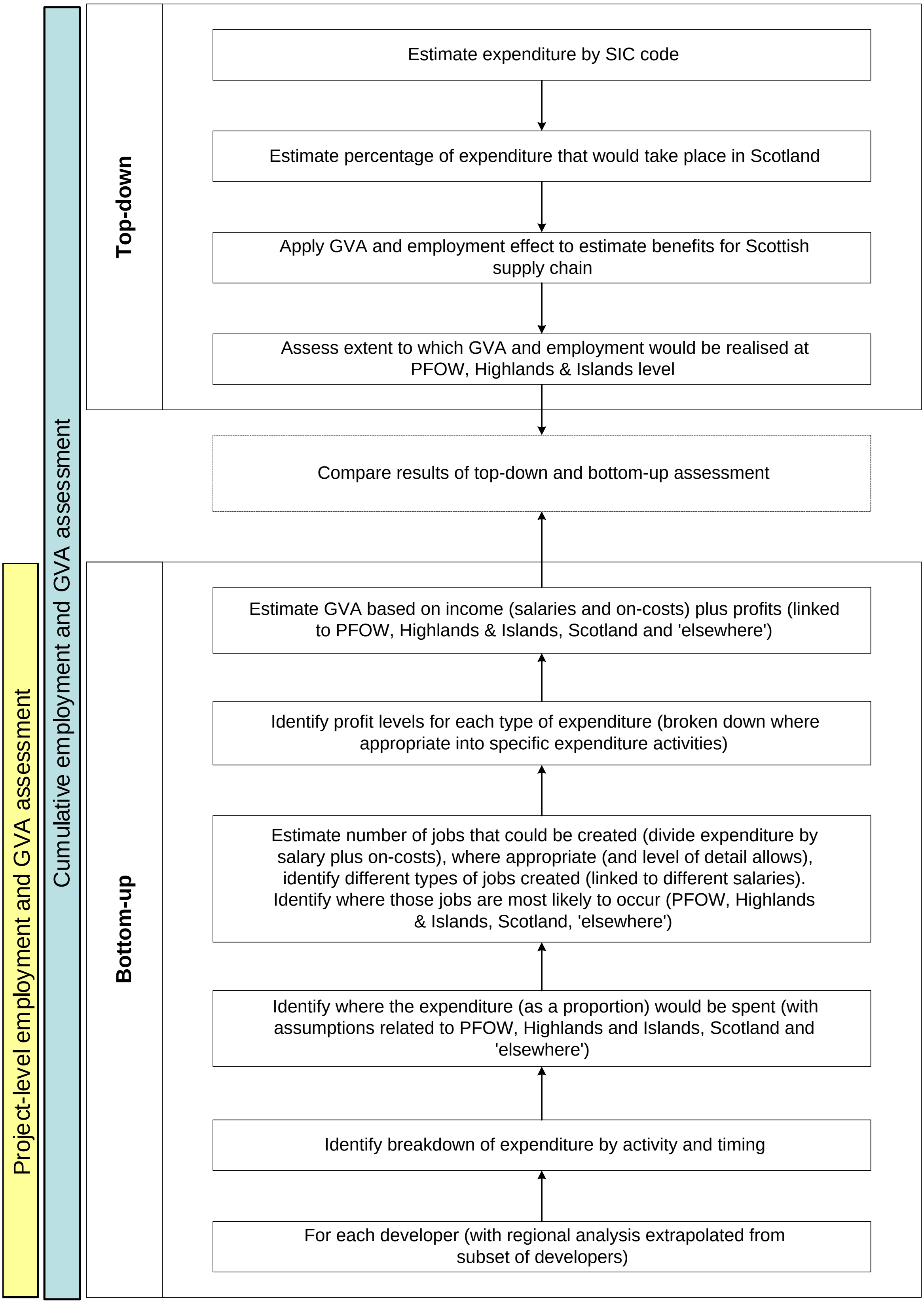


Figure 4. Illustration of Approaches for Top-down and Bottom-up Estimation of GVA and Employment Benefits

For the bottom-up approach, this will require extrapolation of assumptions from project level assessments to encompass all PFOW projects. The top-down approach should take account of planned expenditure across all the PFOW projects and apply national GVA effect and employment effect multipliers to estimate additional GVA and additional jobs created/supported. Both methods essentially estimate the gross impact of PFOW projects on GVA and employment and it is not considered appropriate or feasible to seek to estimate the net effect, owing to the difficulties of establishing a detailed baseline (how energy demands would be met in the absence of PFOW developments. Comparison of the two results will provide an indication of the uncertainty surrounding these estimated benefits.

It is recommended as a minimum, that each PFOW project seeks to estimate jobs created/sustained and GVA as a result of project expenditure, together with an estimate of gross carbon savings. Other potential benefits should be included as appropriate and to the extent information is available.

3.2 Assessing Potential Negative Impacts

Table 3 summarises the suggested approaches for assessing potential negative socio-economic impacts that may be necessary depending on the specific features of each PFOW development, although it is unlikely to be necessary to assess all of these elements for any individual project.

Assessment of potential negative impacts should be proportionate to the scale and nature of the interaction with the relevant interest. The EIA scoping process should be used to identify those interactions with marine uses and other interests that are potentially significant and thus require further consideration within the EIA

In assessing potential adverse impacts, it is appropriate to take account of basic mitigation measures that will be applied to projects. For example, any mitigation measures required to meet legislative requirements should be assumed to be in place (e.g. IALA lighting requirements will be in place to manage navigation risks).

Table 3. Summary of Suggested Approaches for Assessing Potential Negative Impacts

Sector/Interest	Potential Impact	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Commercial Fisheries	▪ Loss of or displacement from traditional fishing grounds	▪ Reduction in landings	▪ Quantify potential displacement effect in terms of fish landings	✓	✓
	▪ Disturbance of mobile species and disruption or damage to habitats, nursery and spawning grounds	▪ Reduction in landings/Catch per Unit Effort (CPUE)	▪ Assessment of species and habitats within EIA/HRA procedures	✓	✗
	▪ Obstruction of navigation routes	▪ Increased steaming times for vessels	▪ Assessment of number of vessels affected and scale of deviation	✓	✗
	▪ Fouling of fishing gear on cables or seabed infrastructure	▪ Loss of fishing gear	▪ Assessment of potential frequency of fouling events	✓	✗
	▪ Consequential impacts to fish processors	▪ Loss of profit for fish processors	▪ Assessment of significance of any reduction in landings to fish producers	✗	(✓)[1]
Commercial Shipping	▪ Obstruction of transiting vessel/ ferry routes; Increased steaming distances/time	▪ Increased costs; increased insurance costs	▪ Assess potential additional steaming distances/times	✓	(✓)[2]
	▪ Reduced turnaround times	▪ Increased costs	▪ Site specific consideration with operator	✓	✗
	▪ Displacement of anchorage areas	▪ Increased costs	▪ Assess potential additional steaming/time costs for alternative anchorages	✓	✗
Ports & Harbours	▪ Obstruction of existing navigation routes	▪ Loss of customers and revenue; increased costs associated with maintaining alternative routes	▪ Discussions with individual port authority	✓	✗
	▪ Reduced development opportunities	▪ Loss of customers and revenue (long-term); increased costs associated with development	▪ Discussions with individual port authority	✓	✗
	▪ Loss or reduced use of dredge material disposal sites	▪ Increased costs of disposal	▪ Discussions with individual port authority	✓	✗
Tourism (inc ecotourism, archaeological heritage)	▪ Impacts to landscape or seascape	▪ Reduction in tourism income	▪ Assess significance of changes through LVIA; consultation with stakeholders	✓	✗
	▪ Changes to the local character of an area	▪ Reduction in tourism income	▪ Assess significance of changes through LVIA; consultation with stakeholders	✓	✗
	▪ Disturbance or injury to coastal or marine wildlife	▪ Reduction in income for ecotourism businesses	▪ Assessment of impacts to sensitive receptors e.g. marine mammals; consultation with stakeholders	✓	✗
	▪ Disturbance or damage to heritage assets	▪ Reduction in visitor attraction income; reduction in wider tourism income	▪ Assessment of consequences for visitor attraction income; consultation with stakeholders	✓	✗
	▪ Disruption to site access	▪ Reduction in attraction income	▪ Assessment within traffic impact assessment; consultation with affected parties	✓	✗
Recreational Boating	▪ Alterations to informal cruising routes	▪ Increased fuel costs for motorized vessels; possible relocation of vessels leading to loss of revenues for supply chain	▪ Assess potential additional fuel costs; consultation with stakeholders	✓	(✓)[2]
	▪ Deterrent to investment in marinas/supply chain	▪ Reduced investment	▪ Consultation with recreational boating sector	✓	✗

Sector/Interest	Potential Impact	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Water sports inc. recreational angling, surfing, windsurfing, kayaking & diving	▪ Impacts to seascape/setting	▪ Loss of revenue for supply chains	▪ Assessment of visual impact within EIA/HRA process; assessment of potential displacement in consultation with stakeholders	✓	✗
	▪ Displacement or obstruction of water sports activity	▪ Loss of revenue for supply chains	▪ Assessment of potential displacement in consultation with stakeholders	✓	✗
	▪ Collision risk for humans or vessels	▪ Loss of revenue for supply chains	▪ Assessment of potential displacement in consultation with stakeholders	✓	✗
	▪ Impacts to wave quality (surfing)	▪ Loss of revenue for supply chain	▪ Assessment of potential displacement in consultation with stakeholders	✓	✗
	▪ Impacts to fish resources (angling)	▪ Loss of revenue for supply chain	▪ Assessment of fish species within EIA/HRA process	✓	✗
Cables & Pipelines	▪ Competition for Space	▪ Increased costs associated with new cable or pipeline laying operations;	▪ Consultation with asset owners/operators	✓	✗
	▪ Increased difficulty of access	▪ Increased maintenance costs for cable & pipeline owners; loss of revenue for asset owners; loss of revenue for dependent businesses/customers	▪ Consultation with asset owners/operators	✓	✗
Social Impacts	▪ Local employment	▪ Reduction in employment opportunities	▪ Based on any negative impacts to other sectors	✓	(✓)[3]
	▪ Infrastructure	▪ Pressure on existing infrastructure	▪ Potential demand in relation to capacity (health services, schools)	✗	✓
	▪ Housing availability	▪ Pressure on housing availability leading to increased housing prices	▪ Potential housing demand in relation to capacity	✗	✓
	▪ Quality of Life	▪ Reduction in welfare	▪ Quality of Life Indicators	✓	✗
	▪ Landscape/seascape	▪ Reduction in visitor attraction income; reduction in wider tourism income	▪ Assessment of landscape/seascape within EIA process	✓	✗

1 Assessment only required if displacement impacts predicted to have a significant impact on landings
2 Assessment only required if displacement impacts occur for more than one project
3 Assessment only required if negative impacts on other marine users are considered likely to have significant impacts on employment

4. Gap Analysis

Readily-available baseline information for those sectors and interests scoped into the socio-economic assessment in Section 2 are presented in Appendix B. The sectors and interests covered are:

- Employment and GVA associated with development of the supply chain;
- Commercial fisheries;
- Commercial shipping;
- Ports & harbours;
- Tourism;
- Recreational boating;
- Water sports;
- Cables & pipelines; and
- Social impacts.

The analysis of available baseline information in Appendix B highlights a number of gaps in the existing data, which will need to be filled by supplementary data collection as part of the EIA process.

Data requirements will depend on assessment methodologies used for each sector. Table 4 presents a summary of the identified data gaps and additional data requirements for each sector, based on recommended methodologies and existing data availability.

Table 4. Summary of Information Requirements to Support Project-Level Assessments Which May Contribute to Regional-Scale Assessments

Sector/Interest	Type of Data Required	Available Data	Recommendations on Additional Data Collection Requirements	
			Project-Level Assessment	Cumulative Assessment
Supply chain benefits	Employment and GVA (bottom-up)	Limited information on current value of wave and tidal investment in PFOW Region, based on allocations from funds and estimates of private investment.	Information on type, timing and location of supply chain expenditure, adjusted for job type, salaries, on-costs and profits	Information on type and timing of supply chain expenditure from a sample of developers which can be used to derive and indicative cumulative view.
	Employment and GVA (top-down)	Estimate of total PFOW project expenditure split by activity.	n/a	Relevant employment effect and GVA effect multipliers.
Carbon savings	Carbon emissions avoided (gross carbon savings compared to an agreed baseline)	Information on predicted installed capacity of PFOW projects and indicative timetable.	Anticipated power output.	Anticipated power output.
Infrastructure improvements	Increased potential for socio-economic growth (qualitative)	National Renewables Infrastructure Plan.	Identification of additional relevant infrastructure.	n/a
Benefits to other marine users and interests	Increase in employment and GVA	No baseline.	Estimate of increased employment and GVA where supporting actions being implemented.	n/a
Social benefits	Increase in employment; Improvement in education and skills, quality of life	Existing levels of employment education and skills, quality of life indicators.	Jobs created/sustained – this will come from supply chain assessment; Qualitative assessment of changes in education/skills and quality of life, based on consultation with stakeholders.	Jobs created/sustained – this will come from supply chain assessment.
Increased knowledge	Potential for economic growth	No baseline.	Qualitative description of benefits.	
Supply chain development/ clustering	Potential for economic growth	Information on existing supply chain.	Qualitative description of benefits.	n/a
Energy security	Energy security and economic resilience.	Energy White Paper.	Qualitative description of potential benefit.	n/a
Commercial Fisheries	Displacement from fishing grounds; Impacts on habitats; Number of vessels affected by obstruction of navigation routes; Frequency of gear fouling events; Reduction in landings to fish processors.	Spatial data on landings values and effort by ICES rectangle 2001-10, supported by sightings data and VMS data (>15m vessels) 2005-08.	Spatially resolved data on fishing areas and values for <15m fleet (from Marine Scotland fisheries study); Consultation with local fishermen on local fishing areas and activities, steaming and haul routes; Benthic habitat impacts from wave and tidal arrays (from EIA); Potential frequency of fouling events.	Spatially resolved data on fishing areas and values for <15m fleet (from Marine Scotland fisheries study); Significance of reduction in landings to fish processors.
Commercial Shipping	Costs from - increased steaming times (obstruction of vessel routes); - reduced turnaround times; - displacement of anchorage areas.	Limited AIS data (two weeks) for vessels >300GT; No information on regional value of commercial shipping.	Spatially resolved information on vessel movements, including vessels <300GT; Information on vessel type and draught supplemented with any additional data from operators on site-specific navigation risk for additional steaming times – this information will be available from Marine Scotland study and site-specific Navigation Risk Assessment; Costs of turnaround times and alternative anchorages from site-specific consultation with operators.	Information should be available from Marine Scotland navigation study.

Sector/Interest	Type of Data Required	Available Data	Recommendations on Additional Data Collection Requirements	
			Project-Level Assessment	**Cumulative Assessment**
Ports & Harbours	Costs from - loss of customers and revenue from obstruction of existing navigation routes; - loss of customers and revenue (long-term) from reduced development opportunities; - maintaining alternative navigation routes; - use of alternative dredge material disposal sites.	Limited AIS data (two weeks) on port access routes for vessels >300GT; information on dredge material disposal locations and volumes; Limited information on planned port investment in wave and tidal infrastructure; Limited information on individual port throughput/turnover.	Information should be available from Marine Scotland study and from site-specific Navigation Risk Assessments; Additional information will need to be obtained through consultation with relevant port & harbour authorities where necessary..	n/a
Tourism (inc ecotourism, archaeological heritage)	Tourism income (reductions, as a result of impacts on landscape or seascape, changes to local character of an area); Impacts on coastal or marine wildlife; Visitor income from heritage assets; Site access.	Information on regional value of tourism but difficult to identify coastal related tourism values.	Project-level EIA will provide information on landscape and visual impact assessment, impacts on wildlife and traffic impacts; Other information will need to be obtained through consultation with relevant stakeholders.	n/a
Recreational Boating	Fuel costs for motorised vessels due to alterations to cruising routes; Reduction in investment in marinas/supply chain.	Limited information on actual sailing/cruising routes, vessel types or vessel numbers; No information on regional value of recreational boating.	Information should be available from Marine Scotland study and from site-specific Navigation Risk Assessments; Other information will need to be obtained through consultation with relevant stakeholders.	Information should be available from Marine Scotland navigation study.
Water sports including recreational angling, surfing, windsurfing, kayaking, and diving	Loss of revenue for supply chain from: - impacts to seascape/setting; - displacement or obstruction of activities; - collision risk; - impacts to wave quality (surfing); - impacts to fish resources (angling).	Limited information on the spatial location and value of activities.	Spatially-resolved information on the location and intensity (numbers of participants) of watersports activities will need to be collected Assessment of visual impact and impacts on fish should be available from project-level EIA Other information will need to be obtained through consultation with relevant stakeholders.	n/a
Cables & Pipelines	Costs associated with: - new cable or pipeline laying operations; - increased maintenance (for cable and pipeline owners); Loss of revenue: - for asset owners; - for dependent businesses/ customers.	Information on the spatial location of cables and pipelines; No agreed method for valuing cables and pipelines.	Consultation with telecom and power cable owners on potential additional maintenance costs of existing telecom and power cables in vicinity of cable crossings and wave and tidal developments; Information on economic cost consequences of delays in maintenance/ repair from consultation with asset owners/ operators.	n/a
Social Impacts	- Local employment opportunities; - Pressure on existing infrastructure (potential demand in relation to capacity for health services, schools); - Pressure on housing availability (potential demand in relation to capacity); - Reduction in welfare; - Visitor attraction income and wider tourism income.	Information on regional and local employment and housing; quality of life indicators; Limited information on proposed infrastructure developments (other than port developments).	Information on employment impacts should be available from individual sectoral assessments; Information should be collected concerning stakeholder perceptions of impacts to quality of life.	Assessment of impacts to infrastructure and housing availability and potential demand will take account of assessment of supply chain employment.

5. Conclusions

The implementation of PFOW projects will give rise to a range of potential socio-economic impacts both positive and negative. Positive impacts (benefits) in terms of GVA and employment will arise as a result of investment in the supply chain including benefits for engineering businesses, shipping and ports & harbours. Reductions in carbon emissions will also be achieved through the use of renewable energy technologies. Additional indirect benefits are likely to arise as a result of the investments, including knowledge benefits, infrastructure and supply chain development and improvements to energy security. The quantification of many of the benefits presents significant methodological challenges and for many of the benefit categories, it will only be possible to provide qualitative descriptions of the benefits. It will be important for developers to seek to quantify the gross employment and GVA benefits of their projects, for which suggested methods have been provided.

Some negative socio-economic impacts may potentially occur to marine users and other interests as a result of interactions with PFOW projects, depending on the nature and scale of the interactions. The main sectors/interests that could potentially experience significant negative impacts include commercial fisheries, shipping, ports & harbours, tourism, recreational boating, water sports, telecom and power cables and social interests. Not all of these interactions will occur for each PFOW development and in many cases, it will be possible to avoid negative impacts through careful project design and the implementation of mitigation measures.

In taking forward their development proposals, PFOW developers should be mindful of the potential for negative socio-economic impacts and seek to minimise such risks through project design. The EIA scoping phase also provides a useful opportunity to consider the extent to which other interests may be affected, to consult with potentially affected parties and to determine whether further assessment of potential socio-economic impacts is required. While this study has identified the main sectors with which PFOW projects will potentially interact, each developer should review this list for their individual project at scoping stage.

To support the assessments, a range of information will be required. Much of the required information is presented in the baseline review (Appendix B) or can be collected by individual developers in completing their EIAs. However, developers should seek to update the baseline information provided for project level assessments, particularly where information has become dated by the time of their application(s).

A number of key information gaps have been identified. Some of these will be filled by ongoing studies, for example, the work of Marine Scotland to map inshore fisheries and to develop baseline information on commercial and recreational navigation interests. Many of the other project-level EIA studies (e.g. Navigation Risk Assessment, ecology impact assessments) will also provide useful information for the socio-economic assessment.

The main areas where developers are likely to need to focus data collection efforts at project level are:

- Information on the type and timing of supply chain expenditure;
- Site specific fisheries information through consultation with local fisheries interests;
- Water sports activities, through site-based surveys;
- Social impacts (understanding community perceptions and values)

While the majority of this information will need to be collected by individual projects, it would be possible to co-ordinate collection of information on aspects such as water sports.

As a starting point for assessments, it may be possible to pre-complete some of the cumulative assessments on behalf of all PFOW developers and to make this information available for individual projects. Key areas where this may be appropriate include:

- Estimation of cumulative gross GVA and employment benefits;
- Estimation of cumulative gross carbon savings;
- Estimation of cumulative displacement impacts for commercial fisheries; and
- Estimation of cumulative effects on health services and housing.

These cumulative assessments may be subsequently modified when it is possible to aggregate individual project-level data.

Based on this study, it is recommended that:

- A common approach should be adopted by PFOW projects in undertaking socio-economic assessments as part of their EIAs. The approach adopted should be incremental and proportionate to the risk and severity of potential impacts and take account of likely information availability;
- PFOW projects should seek to quantify gross employment and GVA benefits associated with their individual developments together with an assessment of gross carbon savings; other potential benefits should be assessed qualitatively;
- The potential for negative socio-economic impacts should be considered at project design stage with efforts made to avoid potentially significant impacts as far as possible. At the scoping stage, any potentially significant negative impacts should be identified (taking account of standard mitigation measures) and taken forward for assessment within individual EIAs; and,

6. References

ABPmer, RPA & SQW, 2011. ABPmer R1743 'Economic Assessment of Short Term Options for Offshore Wind Energy in Scottish Territorial Waters. March 2011

BVG Associates 2011. Wave and Tidal Energy in the Pentland Firth and Orkney Waters: How the Projects Could be Built. Report commissioned by the Crown Estate, May 2011.

Marine Scotland, 2011. Pentland Firth and Orkney Waters, Marine Spatial Plan Framework & Regional Locational Guidance for Marine Energy. Marine Scotland. March 2011.

Scottish Enterprise & Highlands & Islands Enterprise, 2010. National Renewables Infrastructure Plan Stage 2.

Scottish Executive, 2007. Scottish Marine Renewables: Strategic Environmental Assessment.

Appendices

Appendix A

List of Stakeholders Contacted During the Study

Appendix A. List of Stakeholders Contacted During the Study

Association of Scottish Shellfish Growers;

British Canoe Association

British Marine Federation;

British Ports Association;

British Surfing Association

Chamber of Shipping;

Highlands & Islands Enterprise

Local authorities (Orkney; Caithness and Sutherland);

Marine Scotland;

Orkney Island council Marine Services

RYA Scotland

Scottish Boating Alliance

Scottish Fishermens' Federation;

Scottish Salmon Producers Association;

Scottish Sea Angling Conservation Network;

Scottish Surfing Federation

Surfers Against Sewage

UK Cable Protection Committee

UK Windsurfing Association

VisitScotland

Appendix B

Baseline Information

Appendix B. Baseline Information

B1. Introduction

This appendix presents readily available existing baseline information for those sectors and interests scoped into the socio-economic assessment in Section 2. This includes:

- Employment and GVA associated with development of the supply chain;
- Commercial fisheries;
- Commercial shipping;
- Ports & harbours;
- Tourism;
- Recreational boating;
- Water sports;
- Cables & pipelines; and
- Social impacts.

B2. Supply Chain Development

B2.1 National Overview

The provisional Gross Value Added (GVA) for Scotland as a whole (2009) was £102.5 billion[2]. This was a slight reduction from 2008, when GVA was £103.5 billion, but an increase over 2007 where GVA was £99.8 billion (ONS, 2010).

The UK had 3.4 MW of installed marine energy capacity in March 2011 (1.31 MW of wave energy capacity and 2.05 MW of tidal stream capacity), an increase of almost 50% since March 2010 (RenewableUK, 2011). There are also 4 MW of prototypes in advanced stages of planning and fabrication. By March 2011, total allocated public investment was estimated at £55.3 million (UK-wide). This funding comes from the Scottish Government/Scottish Enterprise and Highlands and Islands WATERS fund, the Technology Strategy Board, the Energy Technology Institute and the Carbon Trust Marine Renewables Proving Fund (MRPF) (based on RenewableUK, 2011).

B2.2 PFOW Area

B2.2.1 Information sources

The key published information sources on which this baseline has been drawn are presented in Table B1.

2 Headline Workplace based GVA at current basic prices (NUTS1.1)

Table B1. Published Data Available for Baseline Information on Supply Chain

Scale	Information Available	Date	Source
NUTS3 (also Highlands and Islands, Scotland)	GVA by NUTS3 area (Orkney Islands, Caithness & Sutherland and Ross & Cromarty)	2010 (data for 2008)	Office for National Statistics
Local Authority, Scotland	Number and percentage of employees by job type and role	2010 (data from 2001 census)	Official Labour Market Statistics
Local Authority, Scotland	GVA and employment data for manufacturing (broken down into grouped SIC codes), for construction and for the services sector. Gross wages and salaries by broad industry groups. Ownership by sector (manufacturing, construction, services) in Scotland, UK and Abroad	2010 (data for 1998 to 2008)	Scottish Government

B2.2.2 Activity description

Current Economic Value, Location and Intensity

GVA for the Highlands and Islands in 2008 was £6.9 billion[3] (almost 7% of the total for Scotland) (ONS, 2010).

Further geographical breakdown shows GVA for the Orkney Islands in 2008 at £0.32 billion and at £1.3 billion for Caithness & Sutherland and Ross & Cromarty (ONS, 2010)[4]. Table B2 provides a comparison of the breakdown (total GVA and percentage) by six industries (the maximum detail available).

Table B2 shows that the pattern of GVA contribution from industry groups is similar between Scotland and Highlands & Islands (H&I), with the exception of real estate, renting and business activities (20% at Scotland level but only 13% at H&I level). There are much greater differences between Orkney Islands and Caithness & Sutherland and Ross & Cromarty, and Scotland although it is unclear how much of this is due to the difference in industry groups.

Table B3 provides a breakdown of the percentage of all employees by job type in the local authority areas of Orkney and Highland (which includes Caithness & Sutherland) and Scotland. The table shows that there are fewer managers and senior officials, professional occupations and sales and customer service occupations in Orkney than in Scotland as a whole. However, Orkney has a considerably higher proportion of skilled trades (18.4% compared with 11.2% in Scotland as a whole) and elementary occupations (18.7% compared with 11.7% for Scotland as a whole). Generally, the local authority area of Highland is more similar to Scotland as a whole than Orkney, although it has a higher percentage of managers and senior officials (14.3% compared with 13.1% for Scotland), and slightly higher proportion of skilled trades (13.6% compared with 11.2% for Scotland). There are fewer elementary occupations in Highland (9.3%) than in Scotland overall (11.7%).

Orkney Renewable Energy Forum estimates that there are 140 jobs in Orkney that are already focussed on servicing the developing marine renewables sector. More than 80 professionals work in

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[3] Headline GVA at current prices (based on a five-year moving average)
[4] Headline GVA at current basic prices (based on a five-year moving average)

Orkney's renewables sector, with more than 200 in wider, energy related work. This compares with an estimate 200 jobs in the marine renewables industry, and an estimated 800 full-time employees in the UK as a whole (RenewableUK, 2011).

Table B2. Comparison of Breakdown of GVA By Industry (2008)

Industry Group	NUTS1 Scotland		NUTS2 Highlands and Islands		NUTS3 Orkney Islands		NUTS3 Caithness & Sutherland and Ross & Cromarty	
	GVA (£ bn)	%	GVA (£ bn)	%	GVA (£ bn)	%	GVA (£ bn)	%
Agriculture, forestry and fishing	1.2	1	0.15	2	0.03	9	0.07	5
Real estate, renting and business activities[1]	20.8	20	0.91	13	0.03	9	0.22	18
Manufacturing[2]	13.6	13	0.99	14	0.03	10	0.22	17
Construction	7.3	7	0.59	9	0.04	11	0.12	9
Transport, storage and communication[3]	7.1	7	0.57	8	0.09	29	0.27	21
Electricity, gas and water supply	2.6	3	0.15	2	No data	-	No data	-
Other service activities[4]	Not included	-	Not included	-	0.10	31	0.35	28
Total	**103.5**	**100**	**6.88**	**100**	**0.32**	**100**	**1.26**	**100**

Notes:
1 At NUTS3 level, this is combined into 'business services and finance'
2 At NUTS3 level, this is combined into 'production'
3 At NUTS3 level, this is combined into 'distribution, transport and communication'
4 At NUTS3 level, this includes electricity, gas and water supply

(Source: ONS, 2010)

Table B3. Percent of Employees by Role (2010)

% All in Employment Who Are…	Orkney		Highland		Scotland	
	Number	%	Number	%	Number	%
Managers and senior officials	1,200	11.0	16,400	14.3	324,200	13.1
Professional occupations	1,100	10.3	13,000	11.3	327,700	13.3
Associate prof & tech occupations	1,300	12.3	15,900	13.9	359,400	14.6
Administrative and secretarial occupations	1,200	11.1	13,200	11.5	266,400	10.8
Skilled trades occupations	1,900	18.4	15,600	13.6	275,600	11.2
Personal service occupations	800	7.9	12,300	10.7	235,600	9.5
Sales and customer service occupations	300	2.8	8,700	7.6	212,400	8.6
Process, plant and machine operatives	700	7.0	8,700	7.6	170,500	6.9
Elementary occupations	2,000	18.7	10,600	9.3	289,000	11.7

(Source: NOMIS: http://www.nomisweb.co.uk/default.asp)

Table B4 presents baseline data on gross wages and salaries and total labour costs per employee by industry group for Scotland (across all industry groups; specific data for the marine renewables sectors are not available). The table shows that wages in the local authority areas of Orkney and Highland are typically lower than those for Scotland as a whole, with the difference typically greater for Orkney. The only exception is the service industries (71, 73 and 74) where wages in Highland are lower than those in Orkney. It is difficult to compare the wages with those for Scotland due to the aggregated nature of the Orkney and Highland data, but the range of wages for Scotland as a whole are all higher than the mean service figure for the local authority areas.

Table B4. Gross Wages and Salaries and Total Labour Costs per Employee (2008)

<table>
<tr><th rowspan="2">Industry Group</th><th colspan="2">Orkney</th><th colspan="2">Highland</th><th colspan="2">Scotland</th></tr>
<tr><th>Wages (£)</th><th>Labour Cost (£)</th><th>Wages (£)</th><th>Labour Cost (£)</th><th>Wages (£)</th><th>Labour Cost (£)</th></tr>
<tr><td rowspan="2">All industry groups[1]</td><td>18,026</td><td>20,879</td><td>25,043</td><td>28,930</td><td rowspan="2">21,313</td><td rowspan="2">24,394</td></tr>
<tr><td>15,476</td><td>17,345</td><td>14,165</td><td>15,876</td></tr>
<tr><td>Manufacture of other non-metallic products (26)[2]</td><td>No data</td><td>No data</td><td>30,267</td><td>34,856</td><td>23,194</td><td>26,909</td></tr>
<tr><td>Manufacture of fabricated metal products, except machinery and equipment (28)[3]</td><td rowspan="2">26,115</td><td rowspan="2">29,855</td><td rowspan="2">27,153</td><td rowspan="2">31,535</td><td>30,082</td><td>34,431</td></tr>
<tr><td>Manufacture of machinery and equipment not elsewhere classified (29) [3]</td><td>31,492</td><td>36,170</td></tr>
<tr><td>Manufacture of electrical machinery and apparatus not elsewhere classified (31)[4]</td><td rowspan="2">16,825</td><td rowspan="2">18,675</td><td rowspan="2">30,817</td><td rowspan="2">35,673</td><td>28,495</td><td>32,236</td></tr>
<tr><td>Manufacture of medical, precision and optical instruments, watches and clocks (33) [4]</td><td>34,983</td><td>41,595</td></tr>
<tr><td>Electricity, gas, steam and hot water supply (40)[5]</td><td>No data</td><td>No data</td><td>No data</td><td>No data</td><td>23,949</td><td>27,597</td></tr>
<tr><td>Construction (45)</td><td>18,992</td><td>21,262</td><td>20,871</td><td>23,547</td><td>25,569</td><td>28,739</td></tr>
<tr><td>Renting of machinery and equipment without operator and of personal and household goods (71) [6]</td><td rowspan="3">21,939</td><td rowspan="3">25,419</td><td rowspan="3">17,652</td><td rowspan="3">20,227</td><td>24,673</td><td>28,020</td></tr>
<tr><td>Research and development (73) [6]</td><td>46,803</td><td>57,188</td></tr>
<tr><td>Other business activities (74) [6]</td><td>24,054</td><td>27,324</td></tr>
<tr><td colspan="7">Notes:
1 Top row totals for Orkney and Highland are over industry groups 15-37, bottom row totals for Orkney and Highland are over industry groups 50-93 (excluding 65-67, 75 and parts of 85), for Scotland the total is over 1-85, excluding 1.1-1.3, 65-67, 75 and parts of 85)
2 Totals for Orkney and Highland are across 23, 24 and 26
3 Totals for Orkney and Highland are across 27, 28, 29, 34 and 35
4 Totals for Orkney and Highland are across 30, 31, 32 and 33; data are for 2006 for Orkney and 2007 for Highland (no data for 2008)
5 Data for Scotland are for 2001, data for 2008 not available
6 Totals for Orkney and Highland are across 70, 71, 72, 73 and 74</td></tr>
</table>

(Source: Scottish Government (2010a): Scottish Annual Business Statistics 2008, downloaded from: http://www.scotland.gov.uk/Resource/Doc/933/0104838.pdf (Data for SIC 2003 codes, unless otherwise stated))

Table B5 gives general data for ownership by sector in 2008 at Scotland, UK and 'abroad' scales. These data are for the generic industry sector rather than the specific activities that will be undertaken for wave and tidal energy generation. Specific data will need to be collected from developers to inform the bottom-up assessment of GVA and jobs that could be created in the PFOW, Highlands and Islands and Scotland due to increased expenditure.

Table B5. Ownership by Sector (% Employees, % Turnover and % GVA) (2008)

Industry Sector	Scotland			UK			Abroad		
	% Employees	% Turnover	% GVA	% Employees	% Turnover	% GVA	% Employees	% Turnover	% GVA
Manufacturing	57	34	42	14	37	22	29	29	36
Construction	84	78	77	11	16	15	5	6	5
Services	64	49	53	22	30	26	14	21	22

Notes: [1] Data for 2001, data for 2008 not available

(Source: Scottish Government (2010a): Scottish Annual Business Statistics 2008, downloaded from: http://www.scotland.gov.uk/Resource/Doc/933/0104838.pdf (data for SIC 2003 codes, unless otherwise stated), taken from Annual Business Inquiry)

Table B5 shows that the proportion of employees, turnover and GVA in Scotland is much lower for manufacturing than for construction and services. Although the percentages for Scotland are higher than for the UK or Abroad, there is a much larger proportion of this sector that is outside the UK than for construction or services. The data also only cover firms that have at least one unit within Scotland, so will not include expenditure undertaken by firms based elsewhere.

The activities listed in Table B6 give an indication of the extent to which supply chain benefits could be increasingly retained locally. This information cannot be used to calculate the supply chain benefits directly. However, some assumptions could be made as to the extent to which they would increase retention of supply chain benefits and provide an overview of the additional benefits that might be accrued to Orkney/Caithness & Sutherland. These types of assumptions will be fully recorded and justified (to the extent possible), such that they can be updated in the future as new statistical and/or quantitative data become available.

Table B6. Recently Completed, On-going and Planned Activities That Could Increase the Supply Chain Benefits to Orkney/Caithness & Sutherland

Location	Summary of Improvements	Timeframe	Source
Stromness	EMEC, providing wave and tidal test facilities	2003, extended in 2010	EMEC Orkney
	Orkney Hydrodynamic Research Facility	2009	OREF
Lyness	Deep water quayside base for repair and service of equipment	2005/2006	OREF
	Future development for assembly and maintenance of marine renewables	2009 (commitment) 2010 (plans), 2011 (completion)	Orkney Island Council Marine Services
	New pilot boat	2010	Orkney Island Council Marine Services
Kirkwall	Improvements to infrastructure at Hatston Pier (quay, workspace and lay-down area)	2011	Orkney Island Council Marine Services
University of Highlands and Islands (UHI)	Expansion of teaching, training and research capabilities	2011	Orkney Renewables
Scrabster	Deeper access channel, additional quayside laydown areas with heavy lifting facilities, enhanced range of services at each berth	2011	Scrabster Harbour Trust (2011)

Historical Trends

Of the 3.4MW generated by tidal and wave energy projects installed in the UK, 1.6 MW has been installed at EMEC, with a further 0.25 MW on Islay (LIMPET). There is also 0.25 MW undergoing testing at EMEC. Of the remaining capacity, 1.2 MW is in the Humber Estuary and 0.3 MW is located off the Devon coast. This means that 54% of the capacity is installed in Scotland and 47% in the PFOW area (based on RenewableUK, 2011).

Of the total of £55.3 million public investment in wave and tidal energy in the UK, £30.4 million (55%) was for projects in PFOW (in particular at EMEC) with this associated with private investment of around £55 million. A further £9 million (16%) of public investment was provided to projects in the rest of Scotland. The remaining £15.6 million (28%) is on projects in the rest of the UK, or whose location is not known (based on RenewableUK, 2011).

Future Trends

Planned activity in 2011 includes 2.5 MW of planned installation/deployment in 2011 at EMEC , or 63%. A further 1 MW is to be reinstalled having previously had blade damage, taking the proportion of proposed capacity in the PFOW area up to 88% of planned activity. In addition, preliminary proving trials are to be undertaken in the Moray Firth (based on RenewableUK, 2011). Furthermore, much of the funds allocated to wave and tidal energy is for future development, testing and installation and is yet to be fully spent.

B2.3 Data Gaps and Limitations

The data from the ONS are for 2008 and (provisionally as a total only) 2009. The breakdown by industry is only available across 15 industry groups. It is difficult to assign activities associated with tidal and wave energy to these groups, but a more detailed breakdown of the data is not available. This is further complicated by the breakdown being to six industry groups at NUTS3 level, making it difficult to compare data from Scotland and H&I with data for Orkney Islands and Caithness & Sutherland and Ross & Cromarty.

Data on wages and salaries are only available across a number of aggregated industry sectors for Orkney and Highland. This makes it difficult to compare with statistics for Scotland as a whole. This will mean that assumptions will need to be made in the top-down assessment. A range of estimates (low to high) will be used to help identify the implication of the uncertainties associated with inconsistent and incomplete data.

Data on ownership are only available at a very high level and, as such, are unlikely to reflect the specialised activities associated with wave and tidal power. This highlights the importance of collecting specific data from developers to help fill the gaps for the bottom-up assessment.

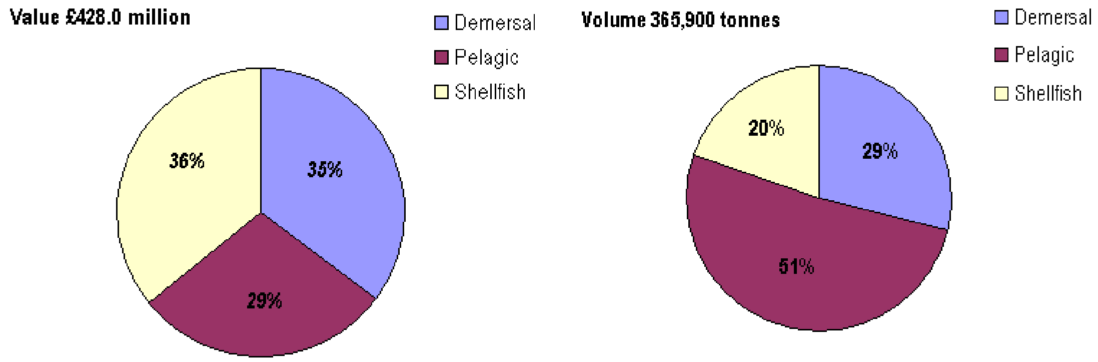
B3. Commercial Fisheries

B3.1 National Overview

Scotland is one of the largest sea fishing nations in Europe and the Scottish fleet is responsible for landing 66% of the total UK volume of fish (Scottish Government, 2010c). Direct employment in the catching sector exceeds 5,000, with an active fleet total of over 2,000 vessels. (Baxter *et al*, 2011). Employment in fishing accounts for 0.2% of the total Scottish labour force, however, in some regions this percentage is much higher, for example, in Orkney the figure was 3.79% of the labour force in 2009 (Baxter *et al*, 2011).

The value of landings by Scottish based vessels was £428m in 2010 (based on provisional figures) (Image B1) and this can be multiplied several times along the supply chain by all the stages of processing and retailing.

The largest part of the commercial fishing industry operates from ports located in the north-east of Scotland, especially around Peterhead and Fraserburgh. This region has the greatest volume and value of landings, as well as a greater concentration of local fish processors and an important level of local economic dependence on fishing activity. (Baxter *et al*, 2011). However, fishing effort has decreased significantly since 2000 due to continuing restrictions on fishing activity in order to promote stock recovery.

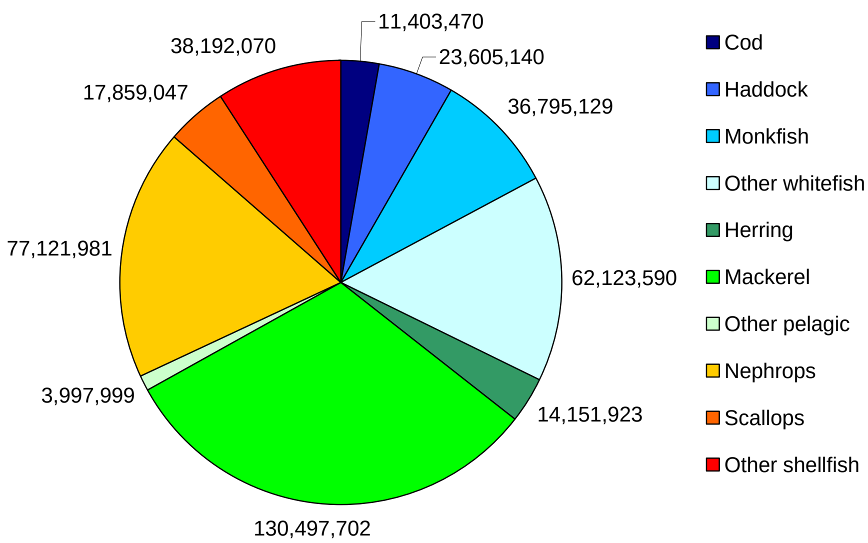


(Source: Scottish Government, 2011)

Image B1. Total Landings by Scottish Based Vessels by Species Type, 2010

The Scottish fleet can be broadly split into vessels over and under 10m in length. The latter tend to operate mainly in inshore waters (up to 12nm from the coast) fishing for a mixture of quota and non-quota stocks. They are relatively lightly regulated compared with the over 10m fleet and also tend to be less powerful, focusing mainly on shellfish (Baxter *et al*, 2011). For all Scottish waters, 68% of active vessels were less than 10m in length in 2009 and 80% were less than 15m.

Eight species make up the bulk of the landings in Scottish ports: mackerel and herring (pelagic); haddock, cod and monkfish (whitefish); Scottish langoustine (Nephrops), scallops and crabs (other shellfish). The relative values of individual fish species caught in Scotland's sea regions in 2009 are shown in Image B2 below.



(Source: Marine Scotland, 2010)

Image B2. Value of Fish Caught in Scotland's Sea Regions by Species, 2009

All fish landings are reported by the areas in which they were caught, known as ICES rectangles covering approximately 30 x 31nm (56 x 57km). This catch information, together with independent fish surveys, form the basis of the data used to assess the amount of fish that can be caught each year. Larger fishing vessels (15m and over) are fitted with a Vessel Monitoring System (VMS), which allows for more detailed and precise information about the location of fishing activity, however, smaller vessels are currently unmonitored by VMS.

B3.2 PFOW Area

B3.2.1 Information sources

The key published information sources on which this baseline has drawn are presented in Table B7.

Table B7. Published Data Available for Baseline Information on Commercial Fisheries

Scale	Information Available	Date	Source
Orkney, Scrabster (also Scotland)	Value and weight of catches by port Average effort (kwDays) in sea areas by UK vessels (range) Average value of landings from sea areas (range) Average number of days of foreign vessel fishing activity per ICES square (range)	2005-2009	Baxter *et al* (2011)
Orkney	Size of fishing fleet	2002-2008	Orkney Islands Council (2010)
	Fishing employment	2000-2008	
	Landings of white fish by Orkney vessels	2002-2009	
	Landings of shellfish into Orkney	2004-2009	
Fishing District	Sea Fisheries Statistics for fishing fleet, employment and catches and landings (Note: provisional figures for 2010 have been published on a national scale only)	2009	Marine Scotland - Science
ICES rectangle	Landings data (weight and value of landings into a UK port by vessel size, nationality and gear type for each species)	2000-2010	Marine Scotland
ICES rectangle	Satellite (VMS) data of UK vessels	2006-2010	Marine Monitoring Centre, Marine Scotland
ICES rectangle	Vessel surveillance data by nationality and gear type	2006-2010	Marine Monitoring Centre, Marine Scotland
ICES rectangle	Fisheries Sensitivity Maps in British Waters	1998	Coull *et al* (1998)

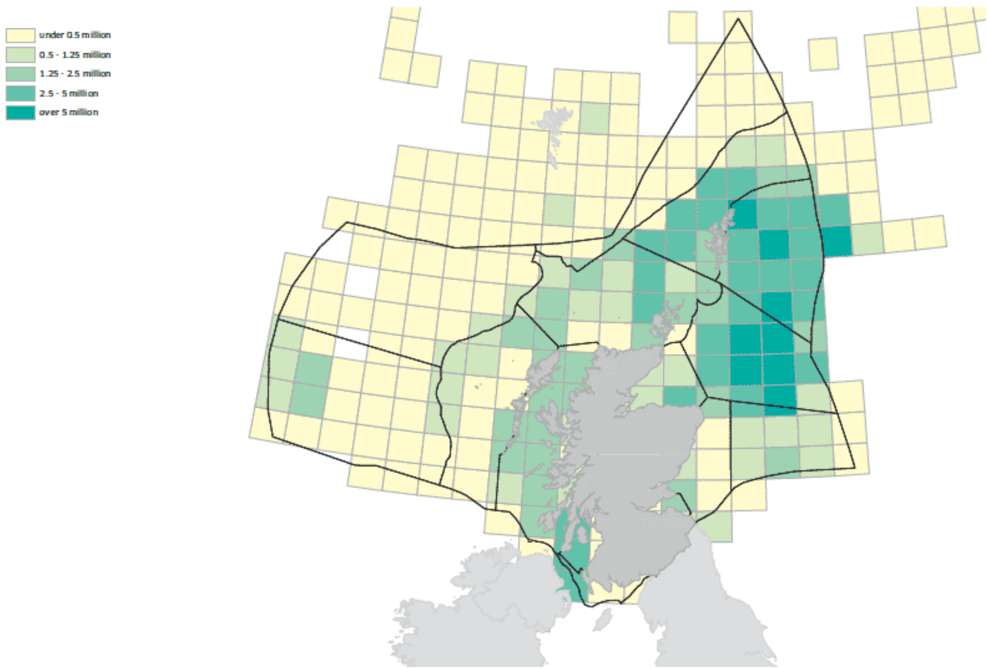
B3.2.2 Activity description

Orkney and the north coast of Scotland support a small local fishing industry and also have some busy fishing ports, notably Scrabster. Fishing is an important employer across the area and related employment, including fish processing and port activities, is also very important. In Orkney, 3.79% of the labour force was directly involved in commercial fishing in 2009, compared with the national average of 0.2%. There are a number of fish processors on the island which process a number of fish and shellfish species, in particular crab, lobster, shellfish (scallops, mussels, oysters), herring, mackerel, salmon, haddock and cod. These processors are largely dependent on local fisheries and aquaculture.

Important fisheries in the area include cod, haddock and monkfish (demersal) and herring (pelagic). For these species, seines and trawls are predominantly used as part of a mixed fishery. Other important fisheries in the PFOW area are: mackerel (pelagic), which are mainly caught using trawls and also hand lines; crab and lobster (shellfish), which are mainly caught using pots from vessels under 15m and also hand fishing from vessels 10m and under; and scallop (shellfish), which are mainly caught using dredges from a variety of vessel sizes and also some hand fishing from vessels under 15m in length.

The majority of these demersal and pelagic species are caught using vessels 15m and over in length, whereas the shellfish are predominantly caught using vessels under 15m in length.

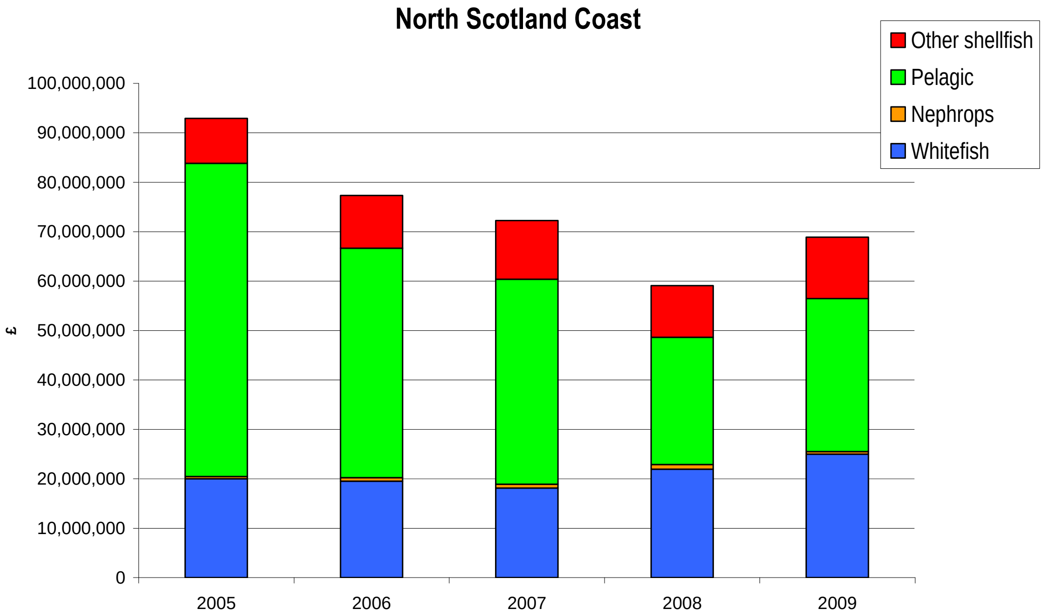
For the North Scotland Coast sea region, the average fishing effort for 2005 – 2009 was 6,775,381 kwDays (Baxter *et al*, 2011). Image B3 shows the average effort levels across the region by ICES rectangle. For the PFOW area in particular, the average fishing effort was between 1.25 and 5 million kwDays.



(Source: Marine Scotland, 2010)

Image B3. Average Effort (kwDays) in Scotland's Seas by All UK Vessels (All Lengths) 2005-2009

The average value (2005 – 2009) of fish caught was £74,097,736 and the average tonnage (2005 – 2009) was 100,802 tonnes (Baxter *et al*, 2011). The value of different species of fish caught in North Scotland Coast in 2009 is shown in Image B4.



(Source: Marine Scotland, 2010)

Image B4. Value of Fish Caught in North Scotland Coast Region by Species, 2009

The PFOW strategic area contains a number of spawning areas for commercially important species, including herring, lemon sole, sandeel, and also nursery grounds including saithe, lemon sole, sandeel and haddock. Sensitive months for spawning fish in the area are November to February and August to September (Coull *et al*., 1998).

Current Economic Value, Location and Intensity of Activity

Figures B1 to B7 show the activities of the commercial fishing sector within the ICES rectangles which overlap with the PFOW strategic area and the marine renewable development sites. The five ICES rectangles are: 46E5, 46E6, 46E7, 47E6 and 47E7.

Figure B1 and Table B8 show the average landings value by species category for each ICES rectangle for the years 2000 to 2010. The value of landings of pelagic species was generally much higher than for other species categories. ICES rectangle 46E6, to the south west of Orkney had the largest value of demersal and shellfish species landings. Overall, 92% of the landings by value were pelagic species (for the years 2000 to 2010).

Figure B2 shows the relative average landings value by species for each ICES rectangle for the years 2000 to 2010. For the whole study area, the largest catch values were for herring and mackerel (including horse mackerel). The largest average catches for any individual species were for Herring from ICES rectangle 47E7, to the north east of Orkney. The largest value catches for crabs and lobsters were in ICES rectangle 46E6, to the south west of Orkney.

Pelagic species were predominantly caught by vessels over 15m in length using midwater trawls and landing greater volumes of fish. The average landing was 281 tonnes for pelagic species, compared with 2 tonnes for shellfish and 1 tonne for demersal species (for the years 2000 to 2010).

Table B8. Average Landings Value (£) by Species Category and ICES Rectangle (2000-2010)

Fishery Type	46E5	46E6	46E7	47E6	47E7
Annual average demersal landings	541,264	2,314,450	187,573	2,370,271	177,482
Annual average pelagic landings	897,157	75,425	67,164	482,760	1,726,433
Annual average shellfish landings	753,276	1,926,563	638,779	1,881,073	2,053,556
Annual average landings	2,191,697	4,316,438	893,516	4,734,104	3,957,471

(Source: Marine Scotland, 2011)

Figure B3 shows the average value of landings by vessel length (for the years 2000 to 2010). ICES rectangle 47E7, to the north east of Orkney, has the largest proportion of landings (by value) caught by vessels over 15m in length (53.2%), whereas ICES rectangle 47E6 has the largest proportion caught by vessels 10m and under (45.5%). For the majority of the area, except ICES rectangle 47E7, a larger proportion of landings by value was caught by vessels under 15m in length.

Figure B4 shows the average value of landings by fishing gear type. Overall, midwater otter trawls had the largest landings values, followed by purse seines with purse lines and midwater pair trawls.

Scottish Sea Fisheries statistics are reported by port district. Scrabster and Orkney districts lie within the PFOW study area and between them they comprise 22 local ports, including Scrabster, Wick, Stromness, Kirkwall and Rousay (Scottish Government, 2010b).

In 2009, the number of active vessels in the Scrabster and Orkney port districts were 129 and 152, respectively. As can be seen in Table B9, the majority (78%) of vessels in the area are 10m and under and over 93% are under 15m in length.

Table B9. Active Scottish Based Vessels by District and Overall Length Group, 31 December 2009

District	10m & under	>10m <15m	15<18m	18<25m	25<35m	35<50m	50m & over	Total
Scrabster	110	12	2	3	2	-	-	129
Orkney	110	31	4	1	5	1	-	152

(Source: Marine Scotland, 2010)

The number of fishermen directly employed in the Scrabster and Orkney ports districts are shown in Table B10.

Table B10. Number of Fishermen Employed by District and Employment Status, 2009

District	Regularly Employed	Irregularly Employed	Total
Scrabster	170	-	170
Orkney	275	146	421

(Source: Marine Scotland, 2010)

The total value of fish landed in Scrabster and Orkney port districts in 2009 was £25,500,000 and £6,263,000, respectively (Scottish Government, 2010b). Table B11 shows the weight and value of landings by UK vessels into Scrabster and Orkney port districts in 2009.

Table B11. Liveweight and Value of Landings by UK Vessels, 2009

District	Total Demersal		Total Pelagic		Total Shellfish		Total Landings	
	Tonnes	£'000	Tonnes	£'000	Tonnes	£'000	Tonnes	£'000
Scrabster	11,204	18,766	7	1	4,330	6,732	15,541	25,500
Orkney	1	1	3	3	3,350	6,259	3,355	6,263

(Source: Marine Scotland, 2010)

The landings data show that the majority of pelagic species were landed at Peterhead, Fraserburgh, Lerwick or foreign ports, whereas shellfish tended to be landed at local ports, such as Kirkwall, Scrabster, Stromness and Wick.

Figure B5 shows the density of UK vessels for the years 2006 to 2010 from satellite tracking using vessel monitoring systems (VMS) onboard fishing vessels over 15m in length. The VMS data comprises "fishing pings", i.e. VMS pings where the average speed since the last ping was over zero and under 5 knots. This is meant to exclude any vessels that are steaming rather than fishing. However, it also means that VMS pings associated with non-towed gears, such as pots (creels) are of questionable meaning.

Figure B5 shows that the highest density of vessels over 15m occurred to the north west of the study area, outside of the PFOW strategic area. Within the PFOW strategic area, the highest density of vessels occurred along the north coast of mainland Scotland within 15km of the coast and also to the south and east of Sanday up to 10km from the coast.

Figures B6 and B7 show all surveillance sightings by vessel type and nationality in the study area from November 2005 to December 2010. Surveillance sightings in UK waters are recorded by fishery protection aircraft and surface craft as a means of policing fisheries legislation and are carried out approximately once a week during daylight hours. Stern trawlers were the most sighted gear type in the area with the greatest VMS density to the north west of Orkney. Within the PFOW strategic area, potters/whelkers, stern trawlers and scallop dredgers were the most sighted gear types over this period. British registered vessels were the predominant nationality comprising 92% of sightings in the study area.

Historical Trends

Looking at longer term trends, the value of demersal, pelagic and shellfish landings in 2009 increased in real terms compared with 2005 by 10%, 19% and 16%, respectively. (Scottish Government, 2010b). However the volume of landings has decreased over the same period.

Future Trends

The commercial fisheries sector is currently, and is likely to remain, important to this rural area of Scotland. There is likely to be increasing downward pressure on the levels of exploitation from fisheries management aiming for targets based on maximum sustainable yields. Past over-exploitation of some stocks means that current stocks are depleted and require time to become re-established (Baxter *et al*, 2011). It is likely that management measures will be introduced to reduce discards and by-catch, and be more responsive to changing patterns of fish migration.

Currently, Scottish Ministers will not licence any expansion in Scotland's existing fishing capacity. So no new fishing licences (which are needed to fish commercially and land a catch for profit; and which also stipulate authorised sea areas, species and gear) will be issued in the foreseeable future (Baxter *et al*, 2011).

Reform of the CFP in 2012 may result in significant changes to the aims and objectives of the policy with a consequent effect on management. The outcome of this reform process cannot be predicted with any certainty but one possibility is that EU fisheries may be managed on a regional basis and fishermen may be more directly involved in the management of the fish stocks (Baxter *et al*, 2011). ABPmer & eftec (2011) recently reviewed the potential implications of CFP reform for fishing stocks as part of an overall appraisal of how environmental state may change over the period to 2030 linked to implementation of the Marine Strategy Framework Directive. This analysis suggested that given past performance of the CFP, dramatic improvements in fish stocks were unlikely to be achieved, although CFP reforms may prevent further decline or collapse of key stocks.

B3.3 Data Gaps and Limitations

The published information on the value, distribution and intensity of commercial fisheries activity in the PFOW area has a number of significant limitations as a baseline against which to assess the impacts of PFOW projects. In particular, data on landings values can only be spatially resolved to ICES rectangle scale (30 x 31nm (56 x 57km) approximately), but fishing effort will not be evenly distributed within these large areas. While some information on the location of fishing activity is available from VMS data, this is only available for vessels >15m, whereas the majority of fishing effort in the vicinity of PFOW projects is likely to be undertaken by vessels <15m.

Surveillance sightings in UK waters are recorded by fishery protection aircraft and surface craft as a means of policing fisheries legislation. This type of data provides a good indication of the distribution of fishing activity by method and nationality, but it should not however be used for quantitative assessments of fishing activity, given the low frequency of the flights over an area, which is generally once a week and only during daylight hours.

Vessels of under 10 metres in length are currently not obliged to submit daily log sheets, however voluntary submissions can be made. The “Registration of Buyers and Sellers of First Sale Fish and Designation Auction Site Scheme” introduced in 2005 contributes to the collection of fisheries data for the under 10 metre fleet. The fisheries statistics for this category, especially in years prior to the introduction of the Scheme, may underestimate the true levels of fishing in areas where a large percentage of the activity is by vessels within this category. This is particularly the case in the PFOW strategic area.

Foreign vessels fishing in the area but landing into non-UK ports is not included in the Marine Scotland dataset.

The available data are also of limited use in identifying cumulative impacts of PFOW projects or in-combination effects with other initiatives that may affect commercial fishing (e.g. Common Fisheries Policy reforms, management measures for new Marine Protected Areas etc). Detailed assessment of such issues requires information on the dependency of individual fishermen on specific fishing grounds.

B4. Commercial Shipping

B4.1 National Overview

Shipping provides for the transport of freight and passengers both within Scottish waters and internationally. The movement of vessels is monitored and recorded by the Maritime and Coastguard Agency, Lloyds List Intelligence and other local organisations. Data sets are not always comparable as different categorisations are used for ports calls, fishing, recreation and traffic which does not stop at national ports, but is considered as transiting traffic passing through the national boundaries and jurisdictions. Lloyds data shows that in 2009, 15,225 vessels arrived at the main Scottish ports. There are no readily available data sets providing a quantifiable measure of vessels transiting within Scottish waters.

B4.2 PFOW Area

B4.2.1 Information sources

The key published information sources on which this baseline has drawn are presented in Table B12.

Table B12. Published Data Available for Baseline Information on Commercial Shipping

Scale	Information Available	Date	Source
Scotland (including Orkney, Shetland and mainland).	Number of passengers, cars and commercial vehicles on ferries (graph), Shipping traffic: number of vessels in a given area during first week of January 2010 (map), AIS regional maps, shipping usage of Pentland Firth.	2005-2010	Baxter *et al* (2011) 'Scotland's Marine Atlas - Information for the National Marine Plan' March 2011
Regional Scale	Regional scale AIS density maps	2005-present	Maritime and Coastguard Agency (MCA) - Direct contact with MCA Office:http://www.dft.gov.uk/mca/mcga07-home/aboutus/contact07/mcga-atoz.htm
Orkney (including some parts of Pentland Firth)	AIS data	2009-present	Orkney Islands Council - Marine Services http://www.orkneyharbours.com/index.asp
North Scotland, Orkney and Shetland	AIS data (third party data suppliers)	Unknown	Lloyds Intelligence Limited http://www.lloydslistintelligence.com Marico Marine http://www.marico.co.uk/

Scale	Information Available	Date	Source
Orkney	Traffic on Stromness-Scrabster ferry route,	2000-2009	Orkney Islands Council (2010)
	Traffic on Shetland-Kirkwall-Aberdeen ferry route,	2003-2009	
	Passenger/vehicles on internal ferry routes,	2003-2009	
	Inter-island ferries (cars, commercial vehicles and passengers)	2001/2-2006/7	

B4.2.2 Activity description

Commercial shipping activities within the study area provide for freight and passenger transport. Commercial shipping routes can be split into two distinct types; transiting vessels passing through the study area, and established ferry services between the mainland and Scottish islands. The movement of vessels is monitored and recorded by the Maritime and Coastguard Agency (MCA) and individual port authorities. Within the study area, Orkney Harbour Authority operates a 24 hours Vessel Traffic Service (VTS) providing an Information Service (IS) for vessels navigating in Scapa Flow, Kirkwall Bay and the Shapinsay Sound. The remaining sea areas not covered by Orkney VTS are overseen by the Maritime Rescue Coordination Centre (MRCC) at Aberdeen.

Shipping within the study area includes vessels transiting from the western Atlantic to the Baltic states and Russia; combined with traffic using Orkney Ports, and Scottish Ports on the mainland. Most of the transiting traffic uses Pentland Firth, which is one of Scotland's busiest seaways. The Pentland Firth is considered as an International Shipping Lane and provides the shortest route around the north of Scotland and is the only practical access to Scapa Flow and the Flotta oil terminal for large vessels.

This intensity of shipping within Pentland Firth is set against a navigational background of strong tidal flows and an area prone to adverse wind and wave conditions. The number of vessels transiting Pentland Firth is displayed in Table B13, if the yearly passing total of 7,955 is averaged, this provides 153 vessels passing through the Pentland Firth each week.

Table B13. Pentland Firth (2009) Marine Traffic

Type of Traffic	Dead Weight Tonnes (Total)	Number of Vessels Passing	Number of Vessels Passing (%)	Average Dead Weight (Per Vessel)
All Traffic	275,564,241	7,955	100%	34,640
Traffic not stopping in UK	144,721,925	3,88	49%	37,222
Traffic stopping at UK port(s)	130,842,316	4,067	51%	32,171
Traffic starting or finishing at Scottish Port	74,520,400	2,019	25%	36,909
Traffic starting and finishing at a Scottish Port (Domestic Traffic)	8,300,648	598	8%	13,880

(Source: Baxter *et al*, 2011)

Navigational routes in the Pentland Firth are complicated, AIS track surveys in the area reveal zig zag tracks where vessels take courses at acute angles across the firth and close inshore to counter tidal streams. Given the complex navigational situation, vessel routing schemes have proved difficult to design due to the limited navigable space. Implementation of traffic separation lanes with two lane traffic in opposing directions is not possible given the relatively narrow channel between Stroma and Swona (MCA, 2000).

Current Economic Value, Location and Intensity

Oxford Economics reports for the Chamber of Shipping have estimated that from a turnover of £9.5 billion, the shipping industry contributes about £4.7bn GVA to the UK. The UK Major Ports Group suggest that ports contribute around £7.7bn to UK GDP. Neither source of information presents a breakdown for Scottish Shipping or Ports (Baxter *et al*, 2011). It can be assumed that shipping transiting the PFOW (and not making landfall at a port or harbour) provides no economic value to Scotland.

The PFOW area is used by a variety of vessels for various cargoes, passenger ferries, recreation and fishing vessels. Assessing the use of this area is based on the information sources publicly available. The MSP Framework for PFOW (Marine Scotland, 2011) uses Automatic Identification System (AIS) data from the MCA as its main data source, augmented by track surveys carried out in summer and winter period during 2006 (see Figure B8).

This data provides a historical snapshot of information on the movements of shipping vessels in the study area it gives a good indication of the routes being taken and the relative difference in traffic intensity on a seasonal basis. The AIS plots are presented within the MSP Framework for PFOW (Marine Scotland, 2011 Ref pg 145-148). This provides an indication of the level of seasonal variation in shipping activities. Information is rendered in vessel track lines, without the ability to interrogate or understand the exact type of vessel, to quantify the number of vessels from destination and origin ports, nor the draught of the vessels represented. All of which would be required to derive a socio-economic evaluation.

In addition, the 2006 AIS data survey only provided data for vessels with a gross tonnage (GT) of 300 or more tonnes (and all passenger ships regardless of size). This leaves a significant proportion of missing vessel tracks which are 'non-AIS' vessels including:

A) Commercial Vessels below 300GT;
B) Recreational Vessels;
C) Fishing Vessels; and
D) Naval Vessels.

AIS data is a relatively new technology (*circa* 2005 onwards) for which long term records are infrequently kept. The most robust data source is the MCA archive of AIS data which is not readily available to third parties outside of Government Organisations. AIS information presented within Scotland's Marine Atlas (Baxter *et al*, 2011) shows information as a gridded density map, which provides an indication of intensity of sea area use, but not any quantifiable detail necessary to carry out site specific evaluation.

Historical Trends

Trends in shipping volumes are intrinsically linked to cargo volumes passing through ports. Obtaining representative historic information regarding vessels numbers is difficult, AIS information provides a brief snapshot of recent shipping trends, but does not present a suitable history to draw conclusive trends.

If cargo handling volumes for ship borne (waterborne) freight are used as a proxy for shipping numbers, the volume of freight for all categories (coastwise, one port and foreign traffic; both incoming and outgoing) passing through the ports fell by 5.5% in 2008 to 67.4Mt, this was 23% less than in 1998. In 2008, exports accounted for 44% of the total freight through Scottish ports and domestic traffic (either coastwise or one port) accounted for a quarter. Imports and incoming domestic freight were much lower, together accounting for 27% of the total freight through Scottish ports.

However it must be noted that cargo volumes do not directly relate to shipping numbers as changes in ship size and technology have allowed greater volumes of cargo to be carried by fewer, faster ships. This is most notable in the containerisation market, where upsizing has led to a reduction of port calls, and a move towards hub-and-spoke services. The introduction of ever-larger container ships has reduced the number of ports at which these ships can call, providing a notable growth in transhipment to medium and smaller ports. Historically, container port throughput has increased up to three times faster than GDP. This trend has been affected by the global down-turn, however this correlation between GDP and container port throughput continues, albeit at a declining level.

Future Trends

Shipping volumes bear a direct relationship to the global economic market. As markets react to the changing financial situation, shipping lines respond with services to move goods and people. The most notable variable which 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.

The introduction of bigger ships places expectations that existing ports will increase the depth of water in entrance channels and alongside berths to accommodate changing ship requirements. This implies that investment is necessary in port infrastructure, both in terms of shore side facilities and access to the ports. Channel width may require increasing to take account of the wider ship beam, plus turning circles have to be enlarged to take account of greater vessel length. Although all of these pressures have to be taken into account, probably the most significant factor to challenge traditional ports in the context of their ability to accommodate bigger ships is sea access, and in particular vessel draught.

In respect of lifeline ferry services, which make up a significant proportion of vessel movements within Scottish waters, the Scottish Government is engaged in a comprehensive review of ferry provision. The Review is considering how ferries should be funded and procured; on what basis fares should be set, what kind of services should be supported with public money and who should be responsible for providing these services. The Ferries Review will result in a long-term Plan for ferry services to 2022 (Baxter *et al*, 2011).

B4.3 Data Gaps and Limitations

There is no published information on the economic value of shipping in Scotland or PFOW area and the only estimates available relate to the UK as a whole.

While the available information on shipping movements within PFOW identifies key shipping routes and trades, there is currently insufficient detail on the numbers of vessels, vessel type, draughts, vessel transit track, and vessel voyage information including port of origin and destination. There is also a lack of information on how traffic varies seasonally.

While much of this information could be obtained from more detailed analysis of collected AIS data, information is also required on non-AIS vessels (smaller fishing and commercial vessels).

Marine traffic information would need to capture a summer and winter period to provide seasonality trends.

There is no clear information on where ships may anchor and if these areas would be near to or be affected by PFOW projects.

B5. Ports and Harbours

B5.1 National Overview

Ports and harbours provide the infrastructure required for transhipment of goods moved by maritime transport and act as safe havens for vessels. Cargo and passenger figures are published each year in the Scottish Transport Statistics and the Department for Transport Maritime Statistics. In 2009, 85.5 million tonnes of cargo was handled by all Scottish Ports and over 10 million passengers were carried by ferries, with 15,222 vessels arriving at Scottish Ports during the same period.

B5.2 PFOW Area

B5.2.1 Information sources

The key published information sources on which this baseline has drawn are presented in Table B14.

Table B14. Published Data Available for Baseline Information on Ports & Harbours

Scale	Information Available	Date	Source
UK	Employment and GVA multipliers for ports (all UK)	2009	Oxford Economics (March 2009): "The Economic Contribution of Ports to the UK Economy" http://www.britishports.org.uk/files/Economic%20impact%20of%20ports%209%20March.pdf
UK	Marine Traffic, passenger numbers and cargo volume	2000-2010	Department for Transport "Transport Statistics" http://www2.dft.gov.uk/pgr/statistics/index.html
UK	Port and harbour locations, port types, port ownership, contact details	Current	Ports & Harbours of the UK, 2011. Website: http://www.ports.org.uk/

Scale	Information Available	Date	Source
Scotland (including Orkney, Shetland and mainland)	Maritime transport statistics and overview, generalised information on Scottish Ports.	2009-2010	Baxter *et al* (2011) 'Scotland's Marine Atlas - Information for the National Marine Plan' March 2011
Scotland	Commercial listings of ports in Scotland, service providers, contact details, description of services and current development plans.	Current to 2009	Port of Scotland 2010 - annual publication (current issue print date 2009)
Orkney Harbours	Economic review	2010	Orkney Islands Council (2010): Orkney Economic Review 2010, www.orkney.gov.uk
Local (Scrabster)	Annual economic output, GVA of impact of activities of Scrabster retained in Caithness, Employment (FTEs)	Date not stated	Scrabster Harbour Trust; reference to economic report from 2008

B5.2.2 Activity description

Within the study area, a number of ports and harbours provide a range of commercial and lifeline services to Scotland and its outlying islands. Table B15 and Figure B9 summarise the ports and harbours within the study area.

Table B15. Ports and Harbours Within the Study Area

Port/Harbour	Ownership	Principal Trade
Orkney	**(North to South)**	
Nouster (North Ronaldsay)	Municipal - Orkney Islands Council	Fishing, Ferry Terminal
Moclett (Papa Westray)	Municipal - Orkney Islands Council	Ferry Terminal
Pierowall (Westray)	Municipal - Orkney Islands Council	Leisure (Marina), Fishing, Ferry Terminal
Rapness (Westray)	Municipal - Orkney Islands Council	Ferry Terminal
Kettletoft (Sanday)	Municipal - Orkney Islands Council	Leisure, Fishing
Loth (Sanday)	Municipal - Orkney Islands Council	Fishing, Ferry Terminal
Backaland (Eday)	Municipal - Orkney Islands Council	Leisure, Fishing
Whitehall Ferry Terminal	Municipal - Orkney Islands Council	Ferry Terminal
Stronsay West Pier	Municipal - Orkney Islands Council	Fishing
Egilsay	Municipal - Orkney Islands Council	Ferry Terminal
Wyre	Municipal - Orkney Islands Council	Ferry Terminal
Rousay	Municipal - Orkney Islands Council	Fishing, Ferry Terminal
Tingwall	Municipal - Orkney Islands Council	Fishing, Ferry Terminal
Balfour (Shapinsay)	Municipal - Orkney Islands Council	Leisure, Fishing, Ferry Terminal
Kirkwall - Hatston Pier	Municipal - Orkney Islands Council	Ferry Terminal
Kirkwall	Municipal - Orkney Islands Council	Leisure (Marina), Fishing, Commercial, Ferry Terminal
Stromness	Municipal - Orkney Islands Council	Leisure (Marina), Fishing, Ferry Terminal
Scapa	Municipal - Orkney Islands Council	Leisure, Fishing,
Flotta - Sutherland Pier	Municipal - Orkney Islands Council	Fishing
Graemsay	Municipal - Orkney Islands Council	Ferry Terminal
Holm	Municipal - Orkney Islands Council	Leisure, Fishing,
Moaness (Hoy)	Municipal - Orkney Islands Council	Ferry Terminal
Lyness (Hoy)	Municipal - Orkney Islands Council	Fishing, Ferry Terminal
Burray	Municipal - Orkney Islands Council	Leisure, Fishing,

Port/Harbour	Ownership	Principal Trade
St Margaret's Hope	Municipal - Orkney Islands Council	Fishing, Ferry Terminal
Flotta - Sutherland Pier	Municipal - Orkney Islands Council	Fishing
Longhope (Hoy)	Municipal - Orkney Islands Council	Leisure, Fishing, Ferry Terminal
Burwick (South Ronaldsay)	Municipal - Orkney Islands Council	Ferry Terminal
Scottish Mainland	**(East to West)**	
Talmine	Municipal – Highlands Council	Leisure, Fishing
Skerray	Trust - Skerray Harbour Trustees	Leisure, Fishing
Bettyhill	Municipal – Highlands Council	Leisure, Fishing
Kirtomy	Private	Fishing
Port Grant (Strathy Head)	Private	Fishing
Portskerra	Municipal – Highlands Council	Leisure, Fishing
Sandside	Private - Sandside Estate	-
Scrabster	Trust Port	Fishing, Commercial, Ferry
Thurso	Municipal – Highlands Council	Leisure, Fishing
Castlehill	Private	Leisure, Fishing
Dwarwick	Municipal – Highlands Council	Leisure, Fishing
Brough	Private - Brough Bay Association	-
Scarfskerry	Municipal – Highlands Council	Fishing
Harrow	Municipal – Highlands Council	Fishing
Stroma	Municipal – Highlands Council	Fishing, Commercial
Gill's Bay	Private/Commercial - Pentland Ferries Ltd	Ferry Traffic
Huna	Municipal – Highlands Council	Fishing
John O'Groats	Municipal – Highlands Council	Leisure, Fishing, Commercial

Table B15 demonstrates the reliance placed on maritime trade and transport within the study area; of this list, 18 ports and harbours are on the Scottish mainland and 28 within the Orkney Isles. The largest ports within the study area are Scrabster on the Scottish mainland providing commercial services and ferry berthing facilities, and the deep water anchorage of Scapa Flow in the Orkneys providing an important hub for ship-to-ship transfer. The majority of smaller port and harbour facilities within the study area provide local berthing for fishing and leisure and lifeline ferry services for communities within the Orkney Archipelago.

Ports within the PFOW area use a number of licensed disposal grounds for port navigational dredgings. These sites are identified in Figure B10. In total, there are 10 disposal grounds within the PFOW area, of which 4 are closed. There are no open disposal grounds located within wave or tidal development sites, there are however some sites (Stromness A (FI040)) located in close proximity to proposed development sites. Depending on tidal flow direction at the time of sediment release, material from disposal activities could interact with development sites.

Current Economic Value, Location and Intensity

In 2008, a total of 67.4 million tonnes of freight was recorded as being lifted by water transport in Scotland. Of this, 23.3 million tonnes was coastwise traffic to other ports in the United Kingdom (including Scotland), 1.8 million tonnes of one port traffic to offshore installations, and 42.4 million tonnes of exports from the major Scottish ports. Only 12.2 million tonnes of waterborne freight was carried for part of its journey on inland waterways in 2008 (The Scottish Government, 2009).

In 2009, the number of jobs for sea and coastal water transport supporting activities was estimated at 4,700, the equivalent GVA was £432 million. In 2007, the number of jobs associated with building and repairing of vessels was estimated at 5,800, the equivalent GVA was £475 million.. These values cannot be disaggregated to individual sea areas (Baxter *et al*, 2011).

Ports within the PFOW area contribute to their local and the regional economy as employers, and through the provision of essential services and facilities as lifeline services for ferries, and berths for fishing vessels. The largest ports within the PFOW are Scrabster Harbour and the Orkney Ports (considered collectively in this section).

Scrabster Harbour has an annual reported economic output of £39m, supporting 339 full time jobs and contributing a GVA impact of £14.6 million. to Caithness. Scrabster Harbour handles a gross tonnage in 2007 of 9.85 million tonnes.. The port also has a significant trade in shellfish (£4.8m) and demersal fish (£17.3m) during 2007. The port also accommodates lifeline ferry service links to the Orkney Isles with 149,000 passenger and 46,000 vehicles. The port hosts international ferry services and cruise liner calls with 6,294 passengers and 2,000 vehicles handled in 2007, returning an estimated £4 million for the Highland economy (Scrabster Harbour Trust, 2008)..

Scrabster is strategically placed to support the renewable sector. In September 2007 the Scrabster Harbour Trust announced a £20 million blueprint for infrastructure developments to service the needs of the offshore oil, gas and renewable sectors. The works aim to enhance Scrabster's ability to accommodate demand from oil supply traffic and the marine logistics required to support developments in the Atlantic and the PFOW area. The first stage of the development commenced in 2010, and aims to deliver an additional 8,500m^2 of pier side laydown area and enhanced heavy lifting facilities. The quayside infrastructure development will be complemented by the strategic acquisition of 30 acres of land zoned for industrial use close to the port (Scrabster Harbour Trust, 2011).

Orkney's location makes it a strategically important base for the offshore oil and gas industry, which is demonstrated by port transport statistics. Orkney is classified as a major port due to its cargo volume throughput; all other ports in the PFOW are classified as small ports as their cargo throughput is less than 1 million per year. Department for Transport (DfT) statistics for commercial ports shows that Orkney Ports have a combined annual cargo throughput of 3.2 million tonnes during 2009 (DfT, 2011). The breakdown of this trade is shown by type in Table B16, the vast majority of goods transhipped are composed of crude oil and its derivatives.

Within the Orkney Archipelago, a number of port and harbours locations directly support the offshore gas, oil and renewables industry. During Spring 2010, work commenced to refurbish the former Royal Naval base at Lyness as a centre for the assembly, storage and servicing of marine renewable energy devices. The planned refurbishment will provide 265 meters of quayside berthing and 4,000m^2 of hard standing. The initial refurbishment will be followed by phased developments to provide industrial and business developments.

A large proportion of shipping movements in and around the Orkney Islands are attributable to local ferry traffic. A variety of ferries operate daily services throughout the year between Orkney and the Scottish mainland. In addition, Orkney Ferries operates numerous daily inter-island services. The operators running services within the PFOW include the following:

- Northlink - www.northlinkferries.co.uk;
- Pentland Ferries - www.pentlandferries.com;
- John O'Groats Ferries - www.jogferry.co.uk; and
- Orkney Ferries - www.orkneyferries.co.uk.

These ferry links are shown in Figure B11 as indicative routes. By viewing AIS plot data for the area, these routes can be more clearly seen, however it becomes difficult to distinguish ferry traffic from other port traffic following the same route (see Figure B8).

Table B16. Orkney Trade by Type

Classification	Type	2008	2009
		(Thousand tonnes)	
Liquid bulk	Liquefied gas	24	19
	Crude oil	4,539	2,983
	Oil products	30	24
	All liquid bulk traffic	**4,594**	**3,026**
Dry bulk	Ores	-	5
	Coal	1	1
	Other dry bulk	4	6
	All dry bulk traffic	**6**	**12**
Other general cargo	General cargo & containers <20'	29	21
Containers	20 ft containers	52	56
Roll-on/roll-off	self-propelled	25	25
Roll-on/roll-off	none self-propelled	84	100
Total		**4,789**	**3,241**

(Source: DfT, 2011: www.dft.gov.uk/pgr/statistics/ - see 'Maritime')

Historical Trends

UK ports handled 501 million tonnes of freight traffic in 2009, 61 million tonnes (11 per cent) less than in 2008. At its peak in 2005, UK ports handled some 585 million tonnes of cargo and with the total tonnage increasing by an average of 1% per annum since 1990. Most of the growth during this period was due to unitised cargo, which grew by around 5% per annum, while bulk traffics grew by 0.5% per annum.

Between 1990 and 2005, rapid growth was seen in deep sea containerised freight with an import driven market of Far East manufactured goods arriving into deep sea container facilities in Southern England. This led to an increasingly tight deep sea container port capacity requirement in Southern England. The knock on effects for medium and small UK ports opened up new markets for feeder transport and short sea shipping routes. This was helped by local planners recognising the benefit in local transport plans strongly supporting sustainable distribution and a continuing role for ports within this overall policy with enhanced road and rail access to regional ports. The effect of the recent economic downturn is marked; 2009 UK freight traffic tonnage figures returned to 1990 levels.

Future Trends

The Government policy for ports was set out in the Interim Report of the ports policy review published in 2007 (DfT, 2007). This report stated that the Government sought to 'encourage sustainable port development to cater for long-term forecast growth in volumes of imports and exports by sea with a competitive and efficient port industry capable of meeting the needs of importers and exporters cost effectively and in a timely manner'.

Under the National Policy Statement for Ports, Nation-wide forecasts of demand for port capacity up to 2030 (based on MDS Transmodal, 2007) suggested the following increases compared to the 2005 baseline: 182% increase in containers; 101% increase in ro-ro traffic; 4% increase in non-unitised traffic. The document states that the Governments view is that there is a compelling need for substantial additional port capacity over the next 20-30 years to be met by a combination of development already consented, and development for which applications have yet to be received. The effect of the recent economic downturn will be to delay by a number of years, but not ultimately reduce, the predicted eventual levels of demand for port capacity (DfT, 2009).

Orkney Ports and Harbours provide a base for the offshore oil and gas industry. UK oil & gas production is projected to decline significantly over time as exploited fields reach maturity (UKMMAS, 2010).

The National Renewables Infrastructure Plan (NRIP) Phase 2 Report (SE & HIE, 2010) identifies the need of further port development and services to support the offshore renewable sector within the PFOW area. Providing deepwater quay space and cranes at deployment sites will increase the number of technologies that will be successfully deployable, including those that require significant fabrication and support infrastructure. All ports in both Caithness and Orkney that could host or are already hosting renewable activities, and all have development plans with at least guideline costs for expansion of existing facilities. These include the following:

- Scrabster – potential fabrication and supply base. Outline planning permission has been obtained for industrial development on 32 acres of land adjacent to the port;
- Lyness – potential fabrication and supply base. Initial refurbishment of the former naval base has been completed with potential for further industrial development;
- Kirkwall Pier – potential fabrication and supply base;
- Hatston Pier – potential fabrication and supply base. Work to extend the pier is scheduled to commence in October 2011;
- Stromness Pier – potential small support vessel base. Subject to planning permission, a new Pier of approximately 110 metres will be built at Copeland's Dock in Stromness commencing in the late autumn of 2011;
- Gills Bay – potential base for large support and supply vessels; and
- St Margaret's Hope – potential base for small support vessels.

Lead times vary, but the NRIP Phase 2 Report (SE & HIE, 2010) suggests three years to delivery should be allowed for, which includes obtaining planning permissions and financing. The NRIP Phase 2 report further suggests that larger scale deployments scheduled from 2017 onwards will need to be determined by 2013, with work needing to begin by 2014 at the latest.

For the purposes of providing indicative phasing timelines for port development, the NRIP Phase 2 Report (SE & HIE, 2010) suggested:

- 2011-2015 – immediate needs being for deployment of devices at EMEC and other testing facilities, before moving on to the deployment of small scale arrays at sites identified in the

PFOW area. This includes survey work undertaken by various types of inshore and offshore survey vessels, predominantly multi-cats (20metres in length) and small workboats (10metres in length). Stromness is likely to be used for the largest number of sites given sailing times and specialist workforce location. Hatston and Kirkwall Harbours could also be used for northerly sites, and Scrabster Harbour and Gills Bay providing mainland facilities for the Pentland Firth. Wick is already hosting survey work boats for offshore wind, and depending on which companies win the Environmental Impact Assessment contracts, White Head (Loch Eriboll) may be used.

- 2016-2020 – assuming the continuing progression of technology development and subject to the necessary grid infrastructure being in place, the industry will move towards deployment of arrays. Considerable associated port infrastructure will be required, the exact specifications for that infrastructure is not yet established, but will be clarified as the technology progresses and financial commitments to grid infrastructure, device manufacture and support vessels are made.
- 2020 onwards – operations and maintenance of installed devices. This activity, for economic and operation reasons, will need to be supported near the development sites. Port facilities to service this requirement will be sought ideally within four hours sailing time.

B5.3 Data Gaps and Limitations

There is limited published information on the economic value of individual ports and harbours within PFOW area, nor how such values may change in the future. There is also a lack of detailed information on vessel movements into and out of individual ports and harbours (see previous section on shipping) and thus how access to and from ports might be affected by PFOW projects.

B6. Tourism

This section provides information relating to the national and regional value of general tourism. Where possible, values related to coastal tourism have been highlighted, as this provides the most relevant information in relation to any potential economic impacts of arising from wave and tidal developments. Tourism is often associated with other specific recreational activities including marine ecotourism, tourism associated with cultural heritage, recreational boating and a range of other water sports. This section focuses on general tourism, ecotourism and tourism associated with cultural heritage. Recreational activities are described in other sections of this report as the interactions and issues in relation to wave and tidal development are often distinctly different. 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.

B6.1 National Overview

There are 27,000 Scottish tourism businesses and more than 200,000 people are employed in tourism in Scotland, representing about 9% of all Scottish jobs (SDI, 2009). Tourism spend in Scotland was estimated at £4072 million in 2010 (VisitScotland, 2011). An indication of the importance of coastal tourism in Scotland is provided by Atkins (2004) who stated that 2.2 million holidays were taken in 2004, generating about £440million (cited in Marine Scotland, 2010).

Expenditure by coastal and marine wildlife visitors in Scotland has been estimated at £163 million (£100 million attributable to coastal wildlife tourism and £63million attributable to marine wildlife tourism), generating £92million of income for the Scottish economy and employing just under 4,400 FTE employees (Bournemouth University, 2010). From these values, the authors estimated that the net economic impact of marine wildlife tourism in Scotland was £15 million, with 633 additional FTE jobs, while coastal wildlife tourism had a net economic impact of £24 million with 995 additional FTE jobs.

VisitScotland statistics suggest that over 80% of visitors come to Scotland primarily to visit historic sites. With over 14,000 accessible coastal and marine cultural heritage assets, Scotland's heritage tourism sector brings in large revenue. Ticket sales for only 20 managed heritage assets (which had reliable economic data) in 2008 brought in revenue of £1.55 million (Baxter *et al,* 2011).

B6.2 PFOW Area

B6.2.1 Information sources

The key published information sources on which this baseline has drawn are presented in Table B17.

Table B17. Published Data Available for Baseline Information on Tourism

Scale	Information Available	Date	Source
Caithness & Sutherland (also for Scotland)	Output of DREAM® model for Caithness and Sutherland showing multipliers for tourism actual spend and tourism accommodation (as affected by wind farms)	Date not stated	Glasgow Caledonian Univ *et al* (2009)
Orkney, Caithness & Sutherland (also Scotland)	Scotland's Coastal and Maritime Managed Heritage Assets, Visitor Numbers and Revenue	2004-2009	Baxter *et al*, 2011
Orkney and Highland	No. units at Local Authority level	1998-2008	Scottish Government (2010a)
	Total employees	1998-2008	
	Total turnover	1998-2008	
	Production of goods and services	1998-2008	
	GVA at basic prices	1998-2008	
	Gross wages and salaries	1998-2008	
	Total labour costs	1998-2008	
	Total output at basic prices	1998-2008	
	GVA per employee	1998-2008	
	Gross wages and salaries per employee	1998-2008	
	Total labour costs	1998-2008	
Orkney	Total travel by transport routes	Oct 2008-Sept 2009	Orkney Islands Council (2010)
	Main purpose of trip	Oct 2008-Sept 2009	
	Average party size	Oct 2008-Sept 2009	
	Area of origin of all visitors	Oct 2008-Sept 2009	
	Average length of stay	Oct 2008-Sept 2009	
	Average spend per person (by type, on local products, by trip type)	Oct 2008-Sept 2009	
	Inflation-adjusted value of tourism	Various (latest 2009)	
	Cruise liner visits	2002-2009	
	Accommodation provision (Tourist Board Members)	2004	Orkney Islands Council (2008)
	Annual spend on tourism in Orkney	2009	AB Associates, 2010.
	Statistics on visitor numbers	2009	

B6.2.2 Activity description

Current Economic Value, Location and Intensity

Tourism expenditure in Orkney in 2009 was estimated to be £31.8 million (AB Associates, 2010). The value of tourism for Caithness and Sutherland tourism in 2008 was estimated at £466m GVA (Glasgow Caledonian University and Cogent Strategies International Ltd study, 2008). While these values relate to tourism across the region, it is likely that coastal tourism will be an important component of these figures. For example, spending time at beaches/viewing coastal scenery was highlighted in 'The Orkney Visitor Survey' as one of the most popular activities undertaken in the area (with over 47% of respondents participating in the activity) (AB Associates Ltd., 2010). In addition, a survey of UK and International visitors to Scotland showed that 55% explored Scottish beaches and coastline during their holiday (n=650; Harris Interactive, 2008).

The total estimated number of visitors to Orkney in 2009 was 141,974 made up of 141,172 air and sea travellers, and 802 yacht travellers (of which around two thirds were holiday visitors (AB Associates, 2010). Orkney attracts predominantly older visitors with 43% being over the age of 55 and a further 18% being over the age of 45, indicating the importance of the "grey market" to the islands (AB Associates, 2010).

Marine wildlife tourism is defined as 'any tourist activity with the primary purpose of watching, studying or enjoying marine wildlife' (Masters *et al*., 1998). The sector may be water-based, land-based, or both and may also be formally organised or undertaken independently (META, 2002). Coastal wildlife tourism in Scotland has a strong emphasis on viewing cliff-nesting seabirds and seals at haul-out sites. Marine wildlife tourism operators provide access to offshore or remote areas to view dolphins, porpoise, basking sharks and seals (Baxter *et al*, 2011). The PFOW area is an important region for nesting seabirds such as Puffins and Fulmars (Scottish Government, 2009). Sites such as the RSPB reserves at Dunnet Head, Marwick Head and Hoy are popular birdwatching attractions for tourists. In addition, the area has an abundance of common and grey seals and a comparatively rich cetacean fauna (consisting predominately of sightings of harbour porpoise, minke whale, white-beaked dolphin and killer whale) (Evans *et al*. 2010; Scottish Government, 2009; Baxter *et al*, 2011). Commercial land-based tours to view marine wildlife from the shore are popular in Orkney (sometimes combined with visiting archaeological heritage sites). In addition, a few boat operators undertake wildlife tours to view marine wildlife at sea both from Orkney and Caithness (Source: http://guide.visitscotland.com; http://www.caithness-sea-watching.co.uk).

Figure B12 shows the PFOW region heritage resources include properties in care, maritime museums, dive-able shipwrecks and the heart of Neolithic Orkney World Heritage Site. The rural nature of Orkney and the north coast of Caithness and Sutherland will mean that the traditional skills and local knowledge can transfer into the heritage tourism employment sector, creating valuable employment opportunities (Baxter *et al*, 2011). Taken from 2008 statistics the PFOW area has 8% of the visitor numbers and 5% of the total income from visitors to managed heritage assets within Scotland. However these statistics do not take into account non-managed assets such as shipwrecks or free visitable sites.

The additional economic income derived from visitors who come to the region specifically to visit heritage assets, cannot be separated from the overall tourism income. An example is the many tour guide companies within the Orkney Isles who will incorporate visits to cultural heritage sites, such as the heart of Neolithic Orkney World heritage site, with wildlife and RSPB sites. A large number of shipwrecks are present in Scapa Flow creating a thriving dive location, the details of scuba diving tourism to the region is covered in Section B8 Water Sports.

Historical Trends

Scottish tourism has grown since 2002 (Scottish Executive, 2006). However, overall tourism spend in Scotland was down 0.8% in 2010 compared to 2009. A subdued recovery in the UK economy with below average growth in domestic demand and consumer spending was thought to be partly responsible for this decline (VisitScotland, 2011).

The number of visitors to Orkney has increased by 18% since 2005. Excluding inflation it would appear there has been an increased tourist spend of £6.6m or 27% since 2005 (AB Associates, 2010).

Future Trends

Estimates suggest that gross tourism revenues in Scotland could increase by 50% on 2005 levels by 2015 (Scottish Executive, 2006).

In the future the tourism sector is likely to continue to expand in areas such as Orkney and northern Scotland with sustained growth in ‘short breaks’ to the coast (e.g. WAG, 2008; Atkins, 2004) and increases in tourist numbers as a result of a warmer climate (Viner *et al*, 2006). Scottish Development International (SDI; 2009) stated that the tourism industry in Scotland has demonstrated consistent and sustained growth, creating further investment opportunities.

The value of marine ecotourism is also expected to continue to grow in the future. For example, the number of tourists undertaking marine wildlife watching trips have almost doubled since 1998, equating to an annual average growth of 8.5% over the last 10 years (O’Connor *et al*. 2009).

B6.3 Data Gaps and Limitations

While general tourism values are available for Orkney, Caithness and Sutherland, information on expenditure specifically related to coastal tourism is limited.

Expenditure relating to marine ecotourism and other forms of specialist tourism is available at a Scottish level but not for the PFOW area.

The majority of cultural heritage assets are free to visit with no on-site management or staff, these sites have limited to no information available on visitor numbers. Many managed heritage assets are staffed by volunteers and are still free to visit making it difficult to obtain accurate visitor numbers and visitor expenditure information. It is also difficult to identify the value from wider tourism and recreation information that can be assigned to coastal and marine heritage assets.

B7. Recreational Boating

B7.1 National Overview

Recreational boating within Scotland is concentrated in the Clyde and along the West Coast, which are the traditional cruising grounds for recreational sailors and power boaters. However, recent developments along the East Coast, and within the Orkney and Shetland Isles have increased the potential for cruising routes linking up the Caledonian Canal to the Shetlands with well placed facilities and stopping points en route.

B7.2 PFOW Area

B7.2.1 Information sources

The key published information sources on which this baseline has drawn are presented in Table B18.

Table B18. Published Data Available for Baseline Information on Recreational Boating

Scale	Information Available	Date	Source
Scotland	Statistics on sailing tourism	Date not stated	Tourism Resources Company Management Consultants *et al* (2010)
'North' (Gairloch to Peterhead, including Orkney and Shetland, Moray Firth) West (Argyll, Ardnamurchan - Gairloch & Outer Hebrides)	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	Date not stated	Tourism Resources Company *et al* (2010)
North Scotland Coast (Moray Firth, and Minches and Malin Sea)	Sailing area value and berth numbers	Date not stated	Baxter *et al* (2011)
Orkney, Caithness & Sutherland	RYA cruising routes and sailing areas (map for all of Scotland, but can see detail for Orkney and Caithness & Sutherland coasts)	Date not stated	Baxter *et al* (2011)

B7.2.2 Activity description

Recreational boating along the North Coast of Scotland and outlying islands of Orkney and Shetland is seen by many as the 'fringe' of recreational boating, but the number of berths available has increased in recent years, following a growth in demand from Scottish residents for home port facilities and to service a growing volume of visitors, many from overseas. The North is characterised by a significant proportion of demand that derives from visitors from outside Scotland, notably other Northern European countries, this overseas demand is notably present in Orkney and Shetland waters, (Scottish Enterprise, 2010).

Informal cruising routes in the study area are shown in Figure B13. These include Wick harbour (marina) and deep water anchorage either directly to the Sheltand Isle or Fair Isle, or via Duncansby Head to the Orkney Isles, or along Scotland's northern coastline. There are few facilities for recreational boaters cruising through Pentland Firth on passage to Cape Wrath and the Hebrides, other than small anchorages, piers and jetties. The principal port of call along Scotland's northern coast is Scrabster which provides a number of marine facilities.

Recent marina developments have provided stopping points along the East Coast of Scotland, making progression to the Isles of Orkney and Shetland a more attractive proposition. The four main marina operators between Inverness and Shetland have grouped together to create the Viking Trail to encourage greater use of the new facilities and open up cruising routes to the northern isles, see Figure B13 for route (www.sailnorthscotland.com).

Until recently the Orkney Islands were viewed primarily as a stopping off point for sailors en route from Scandinavia to Scotland. However, after over £6 million of investment by Orkney Islands Council in breakwaters and pontoons, recreational boaters now have the choice of three marinas to visit at Kirkwall (94 berths), Stromness (64 berths) and a small marina and pontoon facility at Westray. Numerous islands have alongside jetty berthing available and there are also visitor moorings available at locations throughout the islands. The smaller islands are a haven for wildlife, and all have interesting flora and fauna. The net result is that Orkney is now viewed as a destination in its own right by cruising yachtsmen, be they on a circumnavigation of Scotland or Britain, or charterers taking a boat from the charter company based in Kirkwall, (Sail Scotland, 2011) and (Orkney Marinas, 2011).

Scotland's Marine Atlas (Baxter *et al*, 2011) comments that despite the recent downturn in the global economy, and subsequent reduction in disposable incomes, the recreational sector could have the potential to play an increasingly significant role in Scotland's rural economy. This is evident by the recent development of marina facilities at Wick, and the Orkney Islands. Combined with active marketing by marina owners, and support from local authorities (such as Orkney Island's Council as seen in recent developments) the potential for future growth is apparent.

Current Economic Value, Location and Intensity

The Sailing tourism market in Scotland currently accounts for £101 million of expenditure per year and supports a total of just over 2,700 Full time equivalent employment jobs. Non-Scottish boat owners contribute a total of £27 million (27% of the total) and their expenditure supports a total of 724 FTE jobs, see Table B19.

Marine related leisure boating makes a particular contribution to the Scottish rural economy (Table B20). The ABI does not categorise this activity separately; hence it is not possible to extract information on a regional scale. The following information is presented within Scotland's Marine Atlas (Baxter *et al*, 2011).

Table B19. Recreational Boating Contribution to GVA and Employment

Activity	Total (Activity by Scottish and Non-Scottish Boat Owners)	Tourist (Activity by Non-Scottish Boat Owners Only)
Expenditure	£101.3 million	£27.0 million
Employment (FTEs)	2,732	724
GVA	£53.0 million	£14.0 million
FTE Full time equivalent employment		

(Source: Scottish Enterprise, 2010)

Table B20. Sailing Area Value and Berth Numbers 2009

Sailing Tourism Region	Value	Percentage of Total Available Berthing	Number of Pontoons	Number of Moorings	Scottish Sea Areas Included in Value
North: Gairloch, Helmsdale, Peterhead, Orkney, Shetland	£7.9M	7.8%	1,792	224	North Scotland Coast West Shetland East Shetland Moray Firth

(Source: Baxter *et al*, 2011)

Historical Trends

The past 15 years, prior to the recent recession, the Scottish sailing tourism sector grew rapidly. New marinas and expansions of existing facilities were developed and absorbed by the market with marinas and other berthing sources filled up and boat ownership in the UK and overseas growing, generating increasing economic activity (Scottish Enterprise, 2010).

In the UK there is no official, definitive, boat ownership data collated by any organisation. Table B21 presents an estimate of the annual growth in marina operations, as compiled and reported by the British Marine Federation (BMF) from a number of anonymous sources.

Table B21 Estimate of Annual Compound Growth in 'Core' Marina Operations

Area	Growth over 10 Year Timeframe (2000 – 2009)	Growth over 5 Year Timeframe (2004 – 2009)
Clyde	6.1%	7.6%
West	7.0%	5.6%
North & East (including PFOW area)	4.7%	7.0%

(Source: Scottish Enterprise, 2010)

Future Trends

UKMMAS (2010) reports that whilst marine recreation has experienced recent growth, future growth and stability of the sector is dependant upon the general health of the UK economy. A strong economy results in consumers having more disposable income to spend on leisure and recreation activities. As a result of the recent global economic downturn, it is likely there will be some short-term decreases in participation in recreational activities. However, with infrastructure and technology in place to support the sector, it is expected to continue to grow over the long term.

It is also possible that economic factors may present future opportunities for recreational boating in the PFOW where owners who have chosen to sell their craft to save on berthing and maintenance fees may now use this saved capital to charter a boat to experience areas they have previously not cruised in. The allure of the East and North of Scotland, plus the Orkney and Shetland Isles may actual see an increase in recreational activity irrespective of the financial down-turn. Long term, it would be expected that the investment in facilities in terms of marinas and support services, would provide enough incentive to see recreational boating activity increase in the PFOW area.

Climate change may also play a small part in increasing overall participation numbers. As the frequency of months when conditions are more comfortable for tourism in north-west Europe (MCCIP, 2008) improve, the warmer weather is more likely to attract visitors to coastal locations in Scotland. The net result will be an extension of the tourist season beyond its traditional limits and opening up new destinations. Climate change as a positive influencing factor must be balanced against predictions of increased storminess, and the severity of storms. Provided increased storminess is predominantly in the winter months, this may not be a factor in future recreational boating trends.

Scottish Enterprise (2010) report concludes that as long as infrastructure (marinas and shore side facilities) continue to attract investment, the potential for grown in the 'North' which includes the PFOW area, has a potential to see resident berthing increase by 4% per annum. The growth potential in visitor berthing is projected at 5% per annum. Both of these projects bring an associated increase in expenditure into the local economy.

B7.3 Data Gaps and Limitations

The published information on cruising and sailing routes is indicative and there is a lack of reliable data on the actual routes taken by recreational vessels. There is also a lack of information on vessel numbers passing along particular routes.

Information on the economic value of recreational boating is only available at a regional scale.

There is limited information on historical trends in activity and the level of future activity is uncertain, as it is largely dependent on the overall performance of the national economy.

There is no clear information on where recreational vessels anchor in relation to the location of PFOW development areas.

B8. Water Sports

The main water sports undertaken in the PFOW area are recreational angling, surfing, windsurfing, sea kayaking, small sail boat activities (such as dinghy sailing) and scuba diving (Marine Scotland, 2011) and so the baseline review has focused on these activities. Recreational boating activity in larger vessels such as yachts is covered in Section B7.

B8.1 National Overview

Indicative estimates of the number of people participating in these water sports in Scotland have been taken from the BMF Water sports and Leisure Participation Survey 2009 (BMF, 2009). This report estimated that 52,869 adults (> 16 years) participated in surfing, 23,952 adults participated in windsurfing, 12,443 in SCUBA diving, 170,526 in recreational angling, 37,416 participated in canoeing[5] and 23,937 in small sail boat activities in the Border and Scotland ITV regions[6].

While estimates of the value of individual water sports for Scotland is limited, at a UK level the economic value of the surf industry was estimated at £200 million in 2007 (UKMMAS, 2010). The total number of people participating in surfing in the UK in 2009 was estimated to be 645,827 (BMF, 2009). 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 £16.4m p.a.

Radford *et al* (2009) estimated that 125,188 adults and 23,445 children went sea angling in Scotland in 2008 with a total expenditure of £141 million. Sea angling in Scotland supported 3148 FTE jobs in 2008, representing an income of £69.67million[7] (Radford *et al.*, 2009). The same study estimated that if sea angling ceased to exist, 1675 FTEs with an income of £37 million would be lost (cited in UKMMAS, 2010). A review of the economic valuation of sea angling (Defra, 2004) suggested there was a stable or increasing demand for sea angling with increasing use of charter and private boats. A survey undertaken by Land Use Consultants (2006) to estimate expenditure on specialist marine and coastal activities in Scotland showed that the average amount individuals spent on sea angling was £1,375 p.a. (96 respondents, total expenditure of all respondents £131,960) and on shore angling was £861 p.a. (82 respondents, total expenditure of all respondents £70,575).

B8.2 PFOW Area

B8.2.1 Information sources

The key published information sources on which this baseline has drawn are presented in Table B22.

5 Canoeing is a general term for a range of 'paddlesports' which includes sea kayaking, surf kayaking, sit-on-top kayaking and Canadian canoeing

6 Some of these activities are carried out inland as well as at the coast. Table 44 in the BMF (2009) study indicates what proportion of each activity is actually carried out at the coast and this information was used to adjust overall totals.

7 The authors highlighted that the jobs and incomes supported by sea angling in Scotland were estimated using a model of the Scottish economy and not by summing the totals for each region. Hence there was a slight difference between the Scottish totals and the sum of the regional values even though conceptually they should have been identical.

Table B22. Published Data Available for Baseline Information on Water Sports

Scale	Information Available	Date	Source
Orkney and Shetland, North (northern half of HIE area) (also Scotland)	Economic impact of sea angling (by region)	Date not stated	Glasgow Caledonian Univ *et al* (2008)
	Angler days by resident, by origin, by type (short, boat, charter)	Date not stated	
	Expenditure	Date not stated	
	Trends (days fished, competitiveness of region)	Date not stated	
	Output of DREAM® model gives multipliers (associated with angling)	Date not stated	
Orkney & Shetland, Northern Scotland	Estimated regional sea angling activity and expenditure (also for Scotland)	Date not stated	Baxter *et al* (2011)
	Origin and destination of overnight fishing trips to Scotland	2006-2007	Glasgow Caledonian Univ *et al* (2008)
Orkney, Caithness & Sutherland	Surfing locations	Date not stated	SAS (2009) and the 'Stormrider Guides' (http://www.lowpressure.co.uk)
Caithness	Value of ASP competition at Thurso	2010	Event Scotland: http://www.eventscotland.org/funding-and-resources/case-studies/o-neill-coldwater-classic-2010/
Orkney	Value of scuba diving for Orkney	Date not stated	The Orkney Hyperbaric Trust, 2007.
Orkney	Diving locations	2009	VisitOrkney (2009)

B8.2.2 Activity description

Current Economic Value, Location and Intensity

Few studies have been undertaken in the PFOW area on the economic contribution of different water sports. Scuba diving is estimated to be worth at least £3,000,000 a year to the Orkney economy (The Orkney Hyperbaric Trust). While no estimates of the total value of surfing in Orkney or Caithness/Sutherland exists, the value of Scotland's largest surfing event, the O'Neill Coldwater Classic at Thurso East has been calculated. The annual competition is an Association of Surfing Professionals (ASP), World Qualifying Series (WQS) event. The competition is listed as a six star event, the highest rating in the WQS and also the highest rated professional surf contest ever held in the UK (Event Scotland, 2010). The 2010 event achieved estimated spectator numbers of 5,500 over the 8-day event. The event resulted in an estimated expenditure of £440,000 to the local economy and an additional £420,000 within wider Scotland with major influential media coverage totalling a media value of £3.8m (estimated) http://www.eventscotland.org/funding-and-resources/case-studies/o-neill-coldwater-classic-2010/.

While other spots in the region are not as intensively surfed as around Thurso (often owing to remoteness), they are still considered an important recreational resource for local surfers. In addition, many surfers are willing to travel large distances to undertake surfing at good quality spots (Lazorow, 2009). Therefore, high quality waves located in remote areas could bring economic benefits to a rural area through travel, accommodation and subsidence expenditure of visiting surfers.

A study by Radford *et al*. (2009) estimated the sea angling activity and economic value in eight regions of Scotland. Two of these regions, North Scotland and Orkney and Shetland fall within the PFOW region. As the areas in Radford *et al*. (2009) do not align with the PFOW regions the values should only be taken as indicative values for comparison between areas. The total estimated regional sea angling activity and expenditure within these two regions is shown in Table B23 below.

Table B23. Estimated Regional Sea Angling Activity and Expenditure

Region	No. Resident Sea Anglers	Annual Sea Angler Days Spent in Region	% of Total Activity Undertaken on the Shore	Total Annual Sea Angler Expenditure (£M)	% of Expenditure Spent on Shore Angling	Number of Jobs Supported
North Scotland	7894	144346	43%	11.2	41%	299
Orkney and Shetland	2823	74640	46%	6.1	42%	145

(Source: Radford *et al*, 2009)

Surfing and windsurfing

A variety of different types of water craft are used to surf waves including surfboards, bodyboards, windsurfing boards and kayaks (SAS, 2009). Some of the UK's best surfing breaks are situated along the north coast of Scotland. The region receives strong, powerful swells and provides a number of high-quality surfing spots. In particular, the reefs situated around Brims Ness and Thurso are considered to be world-class (SAS, 2009). Orkney also has good quality surfing locations although participant numbers are less than on mainland north Scotland, primarily due to accessibility (SAS, 2010).

The location of major surfing spots in the PFOW area can be seen in Figure B14. Windsurfing on Orkney is a popular activity at Kirkwall's Scapa Beach and Orphir's Waulkmill Bay. In addition, on the west coast of mainland Orkney, the storm beach of Skaill Bay, in Sandwick, are also popular spots (Visit Orkney, 2009).

Angling

The main launch spots for charter based angling are Thurso in North Scotland and Stromness on Orkney (Radford *et al*., 2009). Wreck angling is popular in Scapa Flow and also on other wrecks found offshore from Orkney. Shore angling is undertaken at many locations around Orkney including Point of the Baits (Scapa Bay), Waukmill Bay, Bay of Skaille, Sands of Evie, Tingwall Pier, Kirkwall Harbour, Bay of Heatherquoy, The Barriers and Newark Bay (http://www.seaanglingorkney.com). In Caithness shore fishing is popular in Thurso Bay and Dunnet Head (http://www.caithness.org/fishing/).

Cod, pollack and mackerel, are the most popular target species in Caithness and Sutherland. There is some evidence, however, of sports fishing for rarer species such as porbeagle shark becoming more popular. In Orkney conger eel is found amongst the wrecks of Scapa Flow and is the most popular target species, followed by mackerel and bass (Radford *et al*., 2009).

Scuba diving

The most popular area for scuba diving in the region is around Scapa Flow in Orkney. This body of water is considered one of the finest wreck diving sites in Europe and has ranked among the top five wreck diving areas of the world (Jack Jackson, 2007; Baxter *et al*, 2011). Scapa Flow, covers some 190sq km (73 miles) and is completely protected by a ring of islands. Scapa Flow contains the wrecks of three German battleships; four light cruisers; five torpedo boats, a World War II destroyer (F2); one submarine, 27 large sections of remains; 32 blockships and two British battleships. While scuba diving has predominantly been based in Scapa Flow historically, it increasingly involves diving in other parts of Orkney (Jack Jackson, 2007; VisitOrkney, 2009). Recreational Diving is predominantly charter based with approximately 12 Diveboats and an estimated 3000 visiting divers annually (The Orkney Hyperbaric Trust). The location of popular wrecks dived in Orkney can be seen in Figure B15.

Diving is also undertaken on the mainland with the Caithness Diving Club operating in the region. Dive locations include offshore from Holborn Head, Portskerra, Scrabster, Dunnet Head, Scarfskerry and Duncansby (http://www.caithnessdiving.co.uk). Information on the contribution of scuba diving to the economy of Caithness and Sutherland is limited although the intensity of diving in this area is less than around Orkney.

Kayaking

Kayaking on the sea can involve several different forms. For the purpose of this report surf kayaking is covered in surfing and kayak fishing in angling, with this section focusing specifically on 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 generally limits kayaking further offshore. However, open crossings (between two points such as a headland and an offshore island) often through strong tidal currents are regularly undertaken by more experienced sea kayakers. Kayaking has the potential to be undertaken along all of the PFOW area and is only constrained by the availability of suitable launching spots such as beaches or slipways. In terms of popularity, kayaking around Orkney and the north coast of Scotland is not considered as important as other regions such as the Inner Hebrides and East Grampian Coast (Land Use Consultants, 2006). A number of clubs regularly operate sea kayaking in the region (Source: www.CanoeScotland.org). These include:

- The Caithness kayak club, Wick;
- The Pentland Canoe Club, Thurso;
- The Orkney Sea Kayaking Association; and
- The Kirkwall Kayak Club.

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. The Orkney Sailing Club (http://www.orkneysailingclub.co.uk) has a number of dinghies such as wayfarers, albacores, 505s and lasers and operates out the port of Kirkwall. The Pentland Firth Yacht Club operates out of Scrabster and uses a range of Topper Fleet. The fast handicap fleet includes Lasers, Tasars and Fireballs which are available in Thurso Bay (between Holburn Head and Dunnet Head).

Historical Trends

In a global context, the popularity of water sports and related industries have grown dramatically and have been seen as an increasingly important aspect of the marine leisure and tourism market in recent years (Lazarow, 2007). For example, the surf industry grew by an estimated 10% globally from 2004-2008 (SIMA, 2009).

Factors such as increasingly active lifestyles, greater leisure time and affluence have combined to enhance the attractiveness of sports and physical recreation for the tourist (Cornwall Enterprise, 2001). Furthermore, ongoing technological improvements in, for example, wetsuit technologies mean that people are now able to utilise marine waters for recreational activities further into the winter months.

In a UK context, the participation in most marine leisure and recreation activities has stayed relatively stable or showed an increase in recent years (BMF *et al*., 2009). For example participation in canoeing increased by 0.6%, small sail boat activities by 0.26%, windsurfing 0.19% and surfing 0.29% from 2007-2008 (BMF *et al*., 2009).

Sea angling activity appears to have stabilised over the past decade. In 1970, sea anglers fished on average 36 times a year falling to about 12 times in 1992 and 11 in 2002. Most anglers have also observed a decrease in fish catches and declines in the size of fish caught over the past 15 years (Defra, 2004). To some extent anglers have adapted to changing conditions by switching locations, travelling further and using more powerful boats to extend their search.

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 dependant of 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 recent UK economic downturn may lead 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 (see commercial fisheries baseline) and changes in fish distributions in response to climate change. The nature and direction of these changes remains unclear.

B8.3 Data Gaps and Limitations

Limited information on water sports related expenditure currently exists at a regional level within Scotland or at a local level in the PFOW area.

While some data on intensity and spatial distribution exists for certain activities in the PFOW, information for other activities is not as available or just consists of broad descriptions. More detailed information based on collecting quantified data is recommended. Further guidance on suitable techniques for collecting this type of data can be seen in the 'MEDIN Data Guideline for the Leisure and Recreation Sector' (Pearson *et al*, 2011).

Information on historical and future trends in this report has mainly been based on worldwide and UK trends as specific data for Scotland or the PFOW area is limited.

B9. Cables and Pipelines

B9.1 National Overview

Telecommunication cables within the Scottish Continental shelf include fibre optic international cable links and domestic inter-island cables which are mainly copper wire. Over 4000km of international cables and 600km of inshore cables exist. The North Scotland coast region which encompasses PFOW contains 20% of the length of telecommunication cables within Scottish Waters (Baxter *et a*l, 2011). Submarine electricity cables within Scottish waters are predominately created to connect island communities to the mainland national grid infrastructure (UKMMAS, 2010). 900km of power cables exist in Scottish waters with 190km present in the North Scotland Coast area (Baxter *et al*, 2011).

The Oil and Gas industry is the principal source of fuel and power for Scotland, meeting more than 58% of the primary energy in Scotland in 2008 (Baxter *et al*, 2011). The GVA of the oil and gas sector in the UK for 2008 was estimated at £37 billion with £16 billion of that being estimated for Scotland (UKMMAS, 2010). Pipelines associated with oil and gas are estimated to be 12,800km in length in Scotland although the majority of pipelines exist out with the 12 Nautical Mile limit around the coast. The value of pipelines associated with oil and gas can not be extracted from the overall economic value from the whole sector.

B9.2 PFOW Area

B9.2.1 Information sources

The key published information sources on which this baseline has drawn are presented in Table B24.

Table B24. Published Data Available for Baseline Information on Cables and Pipelines

Scale	Information Available	Date	Source
Pentland Firth and Orkney Waters	Telecom Cable Routes including both in and out of service cables.	Issue 13/ January 2011	KIS-CA http://www.kisca.org.uk/charts.htm
UK	Oil Pipelines - Subsea pipelines and umbilical's related to the petroleum industry.	Current	UKDEAL
North East	All pipelines and cables	Current	SeaZone Solutions Ltd
Scotland	Overview of Telecommunication cables, with lengths of active cables per region. Details of Pentland Firth power cables. Scotland wide oil and gas pipelines including total length per region.	Date not stated	Baxter *et al* (2011)

B9.2.2 Activity description

Current Economic Value, Location and Intensity

There is currently no agreed method for valuing the services provided by pipelines or cables as they form part of a wider infrastructure. Estimates can be made of the replacement cost of the infrastructure, but such estimates will significantly underestimate the value of the service. Conversely, seeking to assign the full cost of the wider service to a limited part of the infrastructure will overestimate the value.

Figure B16 shows the oil and gas pipelines telecommunication cables and power cables which intersect the PFOW area. An oil and gas pipeline is located in the eastern PFOW area but is very unlikely to interact with any of the PFOW projects. There are four international telecommunication cables transecting the PFOW area, only one of which (the Northern Lights cable) is considered likely to interact with PFOW projects. A number of power cables are present within PFOW area including connections between the Orkney Islands and a link to mainland Scotland. Only one power cable, situated between Rousay and Westray, is considered likely to interact with PFOW projects.

Northern lights is a BT telecommunication cable which runs from Dunnet Head on mainland Scotland to Skaill on mainland Orkney intersecting through West Orkney South, West Orkney Middle South and Brough Head wave sites. The cable has sections which are buried and sections which are surface laid. The section of cable which intersects with the wave lease sites is surface laid.

Historical Trends

The ‘Northern Lights’ telecommunication cable owned by BT was installed in June 2008

No information was obtained on the date of installation of the power cable between Rousay and Westray. The deployment of power cables has steadily been on the increase in recent times due to the increasing demand for reliable electricity sources (UKMMAS, 2010).

Future Trends

Due to the need to connect wave and tidal renewable energy and offshore wind farm developments to the national grid power supply, the number of sea bed power cables is expected to increase significantly over the next decade and beyond.

At present it is unlikely that any more oil and gas pipelines will be constructed within PFOW area as the majority of oil and gas activity is further offshore in the North Sea or north of the Shetland Isles. The extent to which new submarine telecommunication cables which will be laid within the PFOW area is not known (Baxter *et al*, 2011).

B9.3 Data Gaps and Limitations

The data available on cables and pipelines is limited with telecommunication cables having more readily available information than power cables. Although the location of power cables is known any information on installation and use is hard to come by.

It is difficult to value a cable or pipeline as there is no agreed methodology available. The approaches used at present will either result in a under or over estimation of the actual value of the cables and pipelines. An agreed methodology would allow for a comparison with other marine users and activities.

B10. Social Impacts

B10.1 National Overview

Scotland is a varied country which consists of extremely rural areas through to highly populated cities. This variation creates different social interactions within community structures. An overview of Scottish social issues and data trends are described below, focused on the Highlands and Islands region.

There is no consistent definition of the scope of social impact assessment. For the purposes of this study, the following elements have been identified as potentially being significantly affected by PFOW projects:

- Employment;
- Infrastructure (hospitals, schools);
- Housing;
- Landscape and visual impacts; and
- Quality of life.

Scotland has seen an increase in unemployment since January 2009 (at the start of the economic recession) after a trend of slowly decreasing unemployment from the end of 2006. The Highlands and Islands region has had a consistently lower unemployment rate when compared to Scotland between 2006 and 2009. However seasonal unemployment is prevalent in The Highlands and Islands due to the reliance on tourism and agricultural employment sectors, which are mainly active during the summer months.

In 2008 the Scottish Government released an Infrastructure Investment Plan (Scottish Government, 2008a) with a key priority to invest in “infrastructure and place which adds value and reduces whole life costs”. This includes an investment into a number of capital projects within the Highlands and Islands. House prices, from 2005 to 2008, increased within Scotland by 31% and within the Highlands and Islands the increase was 35%.

From 2008 to 2010 there was a 17% decrease in new housing supply in Scotland as a direct impact of the economic recession and a reduction in new builds from private companies (The Scottish Government, 2010c).

Scotland is highly coastal and therefore has a large variety of seascapes which are perceived to have different scales of value, with large rural open sea views and intricate island complexes having higher experiential values than areas with large scale infrastructure and industry (Scottish Executive, 2007).

The Scottish ‘way of life’ is one of the attributes making Scotland a top tourist destination, the Highlands and Islands is predominantly rural areas with strong tourism and agriculture sectors which creates small “close-knit” communities. Characteristics of such communities are low crime rates and a prevalence of pride in their local area. Quality of life indicators show 69% of Highland and Island residents rate their local area as a "very good place to live" and only 9% perceive vandalism to property as a problem, both these statistics are improvements on the Scottish average rates (HIE, 2011a).

B10.2 PFOW Area

B10.2.1 Information sources

The key published information sources on which this baseline has drawn are presented in Table B25.

Table B25. Data Available for Baseline Information on Social Impacts

Scale	Information Available	Date	Source
Orkney	Orkney Economic Review - information on labour market, economic activity, population and housing.	2010	Orkney Islands Council
Local authority	Employment by industry sector	2009 - 10	NOMIS
Orkney	Area Profile for Orkney including information on population structure, population change, migration, unemployment, economic activity, incomes, educational attainment, house prices and quality of life indicators	2011	Highlands & Islands Enterprise
Caithness & Sutherland	Area Profile for Caithness & Sutherland including information on population structure, population change, migration, unemployment, economic activity, incomes, educational attainment, house prices and quality of life indicators	2011	Highlands & Islands Enterprise
Local Authority	Percentage of adults who rate their neighbourhood as a very good place to live	1999/00 to 2007/08	Scottish Neighbourhood Statistics
Pentland Firth and Orkney Waters	Seascape Assessment – An outline of the potential impacts on the seascape resource of the study area.	2007	Scottish Marine Renewables SEA
Orkney and Highlands	Consultation responses: Securing the Benefits of Scotland's Next Energy Revolution - Community and organisation views on economic benefits from wave and tidal energy.	2011	The Scottish Government

B10.2.2 Activity description

Current Economic Value, Location and Intensity

Local Employment

The remote nature of PFOW areas has an impact on the job market with a more restricted opportunities present than observed within Scotland as a whole. In both Orkney and Caithness and Sutherland the sector of public administration, education and health is the largest employer, accounting for 36% of employees in Orkney and 30% in Caithness and Sutherland in 2008 (HIE, 2011b & 2011c). Small businesses and self employment are also strong contributors to the job market. In 2008 the self employed within Caithness and Sutherland comprised 12% of the working population, in Orkney the figure was 10%; this is an increase of at least 3 percentage points on the Scottish average of 7% (HIE, 2011b & 2011c). The high levels of self employment can be linked to a reliance on tourism and recreation as important sectors within the region. Small scale family farms are traditionally a major employer; within Orkney, agriculture is the second largest employment sector (Orkney Islands Council, 2010).

For the period of 2003 to 2009 unemployment within Orkney has been consistently below that observed within Scotland (Orkney Islands Council, 2010). A small increase in unemployment was seen at the start of 2009 when the economic recession hit; however, the level of increase is much lower than the increase for the whole of Scotland (HIE, 2011b). This suggests that employment is more stable within the Orkney Isles than seen on Scottish Mainland. Unemployment for Caithness and Sutherland recorded for 2006 to 2009 showed that it was above the Scottish average until mid 2008 to the start of 2009 where the Scottish average increased above that seen in Caithness and Sutherland suggesting again this area was less impacted by the recession (HIE, 2011c).

An important source of employment within Caithness and Sutherland is the decommissioning of Dounreay Nuclear Power plant, which is scheduled to continue until 2025. The future of stable employment within Caithness and Sutherland will have to be adaptive, with emphasise on the renewable energy sector and increased tourism (HIE, 2011c).

Infrastructure

The transport infrastructure within the highlands and islands includes road and rail networks, airport traffic and a heavier reliance on ferry routes than the average seen across Scotland, most prevalent within the Orkney Isles (Orkney Islands Council, 2010). Public infrastructure also includes electronic infrastructure, hospitals and education (schools and universities). The dispersed structure of highland and island communities creates a high reliance on well maintained and suitable transport infrastructure and health and education infrastructure which can handle the level of demand as in most areas there will only be one option for most local communities (The Highland Council, 2010).

Over the past 5 to 10 years there has been a growth in investment in infrastructure within Scotland; however the economic recession saw a reduction in public funds available for this investment. The Scottish infrastructure investment plan 2008 declared its main focus on infrastructure improvement will be on “improving connectivity; providing sustainable, integrated, and cost-effective transport alternatives to the car; and improving the planning and development regime” (The Scottish Government, 2008b). Examples of recent planned and underway infrastructure improvements within Orkney and Caithness and Sutherland include the implementation of improved broadband services via UK and Scottish Government funding (HIE Website). Improvements to ports, harbours and network links are funded through the Scottish Government, European funds and industry as part of the National Renewables Infrastructure Plan (NRIP) (Scottish Enterprise, 2010).

Economically the improved infrastructure is expected to lead to greater opportunities for the offshore energy sector but would also help strengthen industries which already rely on the current infrastructure such as commercial shipping.

Housing availability

House prices in Orkney and Caithness and Sutherland are on average lower than those observed in Scotland. The housing market within the region for the period of 2005 to 2008 had an increase, in house prices of lower than 20% compared to an average increase of 30% within Scotland. House prices within Orkney and Caithness are relatively stable however within Sutherland there are high numbers of second and holiday homes which could push up house prices for residents. Orkney saw an increase in house prices during 2009 compared to a decrease in the Highlands and Islands and the whole of Scotland (HIE, 2011a). The economic recession had less of an impact on Orkneys employment and housing market. Future trends of house prices are predicted to remain stable within the area, with slight rises in prices but on average lower prices than seen within Scotland.

Landscape and seascape

A Seascape can be described as “the coastal landscape and adjoining areas of open water, including views from land to sea and along the coastline” (DTI, 2005). The complete assessment of wave and tidal power development on the landscape and seascape is covered by the Scottish Marine Renewables: Strategic Environmental Assessment (Scottish Executive, 2007).

Orkney’s Seascape characteristics comprise: low coastal sands and flats; high cliffs; inter-island associated with other islands areas; and low lying agricultural coastal fringe. The experiential qualities of these landscapes range from a sense of wilderness from dramatic rugged remote sites to flat uninterrupted open sea views with a calming quality.

Caithness and Sutherland have seascape characteristics of: Low coastal sand and flats; high cliffs; complex indented coastline with offshore islands; rugged coastal shelf; and headlands with open views to sea. The key experiential qualities include a sense of remoteness and exposure linked to the exhilarating and dramatic nature of the views. The complex indented coastline with offshore islands, create a sense of tranquillity with the intimate scale of these seascapes.

The economic value associated with the seascapes can only be assessed via the unique qualities such a seascape and landscape will have and the demand to keep such an area without change. The value of tourism and recreation (see Section B6 - tourism) brought into the area for the unique and remote nature of the landscape can be used as an indicator as to the value which can be attributed to the seascape.

Due to the nature of the value, recent historic trends show little change to the landscapes as this untainted landscape is the quality which is of value. Future trends in improved infrastructure and expansion of the offshore renewables sector could have impacts on the current valued qualities of the PFOW areas seascapes and landscapes. The remote nature of the seascapes make it susceptible to negative change from any infrastructure or large scale development being added to the seascape, with more open views less susceptible than small scale views associated with inter-island and indented coastlines.

Quality of life

The perceived quality of life within the study area against Scotland as a whole provides an indication of the value of traditional life against the average represented by Scotland. The highly coastal nature of the PFOW area will have a large impact on traditional life; Gee & Burkhard (2010) identified “the sea as a symbol of trade, of tradition and identity". Traditional 'ways of life' within Orkney and Caithness and Sutherland will be intrinsically linked to the coast and sea.

Orkney has low unemployment rates and relatively small increases in the housing market over the last 5 years give an indication that the quality of life is high within the islands with less of an impact from the economic recession than felt across the rest of the UK. The Scottish household survey taken in 2005/06 reported that 79% of the Orkney population rated their local authority area as a very good place to live in comparison with only 52% in Scotland and 69% for the Highlands and Islands (HIE, 2011a).The crime rate of Orkney is also dramatically reduced, 295 in 10,000 population when compared to Scotland, 749 in 10,000 (data collected 2007/08). The Highlands and Islands also show a higher rate (575 of 10,000) of crime than Orkney but lower than Scotland. None of the Orkney population lives within the 20% most deprived data zones in Scotland, which is a measure of the Scottish Index of Multiple Deprivation (SIMD) that identifies small area concentrations of multiple deprivation across all of Scotland (HIE, 2011a).

The population of Orkney increased by 3.85% between 2001 to 2009 which is slightly higher than the average for Scotland (2.48%). The distribution of population has seen an increase in the 45 to 64 and the 65 to 84 age brackets and a decrease in the 20 to 44 age bracket (HIE, 2011b). The ageing population could be due to the limited employment opportunities available outside of the services and agricultural sectors. Limited higher and further education opportunities also play a part in the migration of young people out of the Highlands and Islands. However from a survey in 2009 over 80% of young people within the region perceive their local community as a safe place to live and over 70% perceive it as a place they feel proud to be associated with (HIE, 2009).

Caithness and Sutherland is also seen to have a high quality of living. An increase in unemployment from 2006 to 2009 was shown, but not to as large an extent as within Scotland. The housing market is also more stable with smaller rises in house prices over the last 5 years than in Scotland as a whole. The percentage of the population of the Highlands which rate their local authority area as a very good place to live is 69%, which is greater than 52% for Scotland (HIE, 2011a). The population of Caithness and Sutherland is aging to a similar extent as Orkney, with increases in the over 44 age brackets and a reduction in the 20 to 44 age bracket.

Small widespread communities are most common within Caithness and some areas of Sutherland with small rural agriculture being a large employer. The traditional life styles present in this area could be susceptible to change through increased population densities and developmental changes to the rural landscape.

Future trends for the 'way of life' within the PFOW study area could show a stable population with a reduction in the younger worker generations due to availability of opportunities. However the majority of residents perceive their local area as a very good area to live and thus the quality of life is perceived as higher within these regions.

Historical Trends

The population of Orkney increased by 3.1% to 19,870 between 2001 and 2007 (Hall Aitken, 2009). Over the same period, the age profile changed, with an increase in the proportion aged over 55, and a drop in children under 15 years old.

Future Trends

Employment and economic opportunities are central to population change, and limited job opportunities and low private sector earnings contribute to out-migration. However a strong enterprise culture, expansion in further and higher education and renewable energy developments all offer good prospects for attracting migrants and returners (Hall Aitken, 2009).

B10.3 Data Gaps and Limitations

While it is possible to establish quantitative estimates for social impacts such as employment, reliable valuation of social impacts such as changes in 'seascape and landscape' and 'way of life' is extremely difficult.

Information from consultation with local communities can help to identify the aspects of the 'way of life' which they value the most. These aspects could then be valued using techniques such as willingness-to-pay.

The majority of statistical data are split by region including Orkney and Caithness and Sutherland. However only the north coast of Caithness and Sutherland is included in the PFOW area therefore these values could be skewed by data retrieved from communities' situated further inland.

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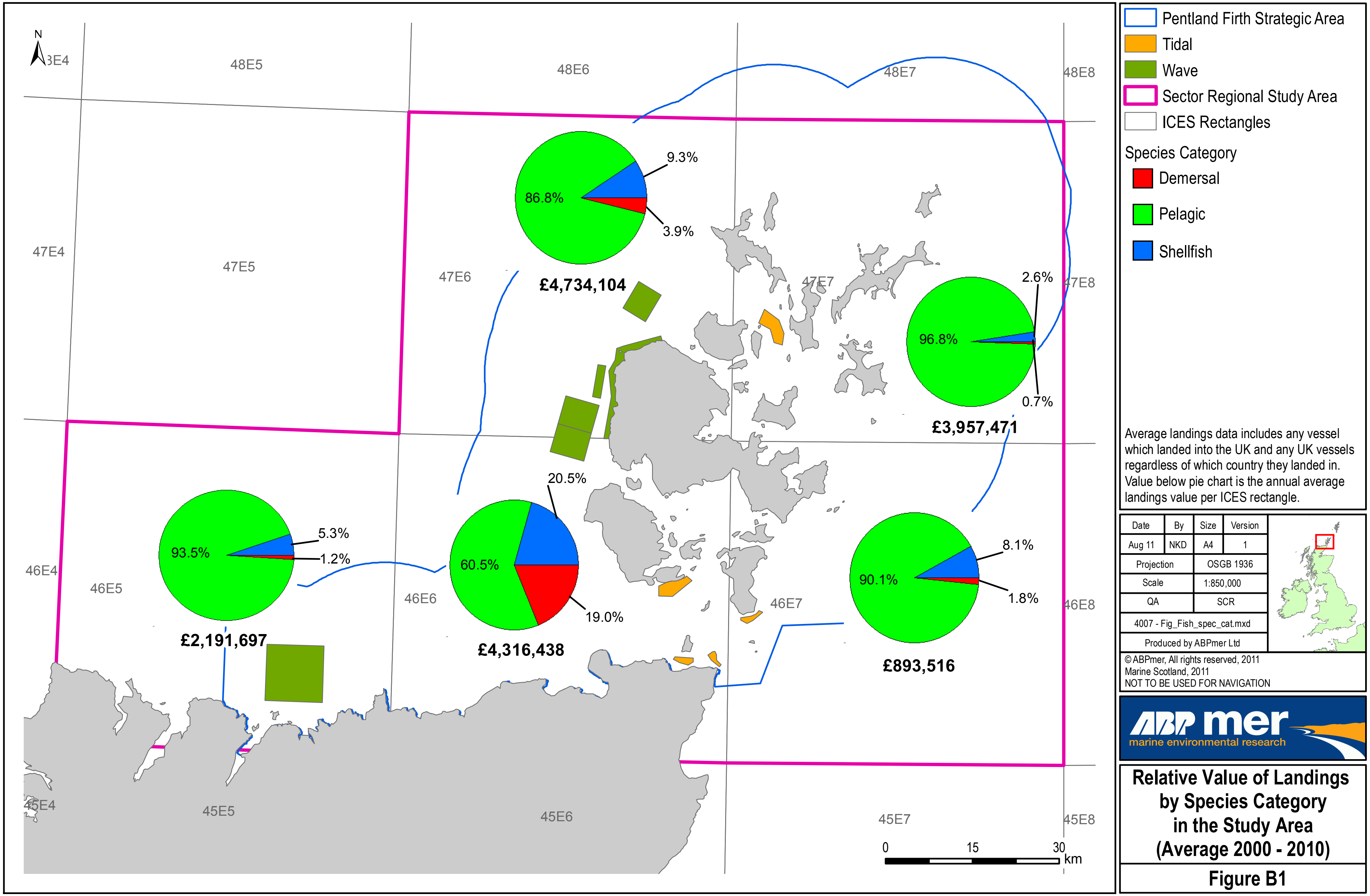
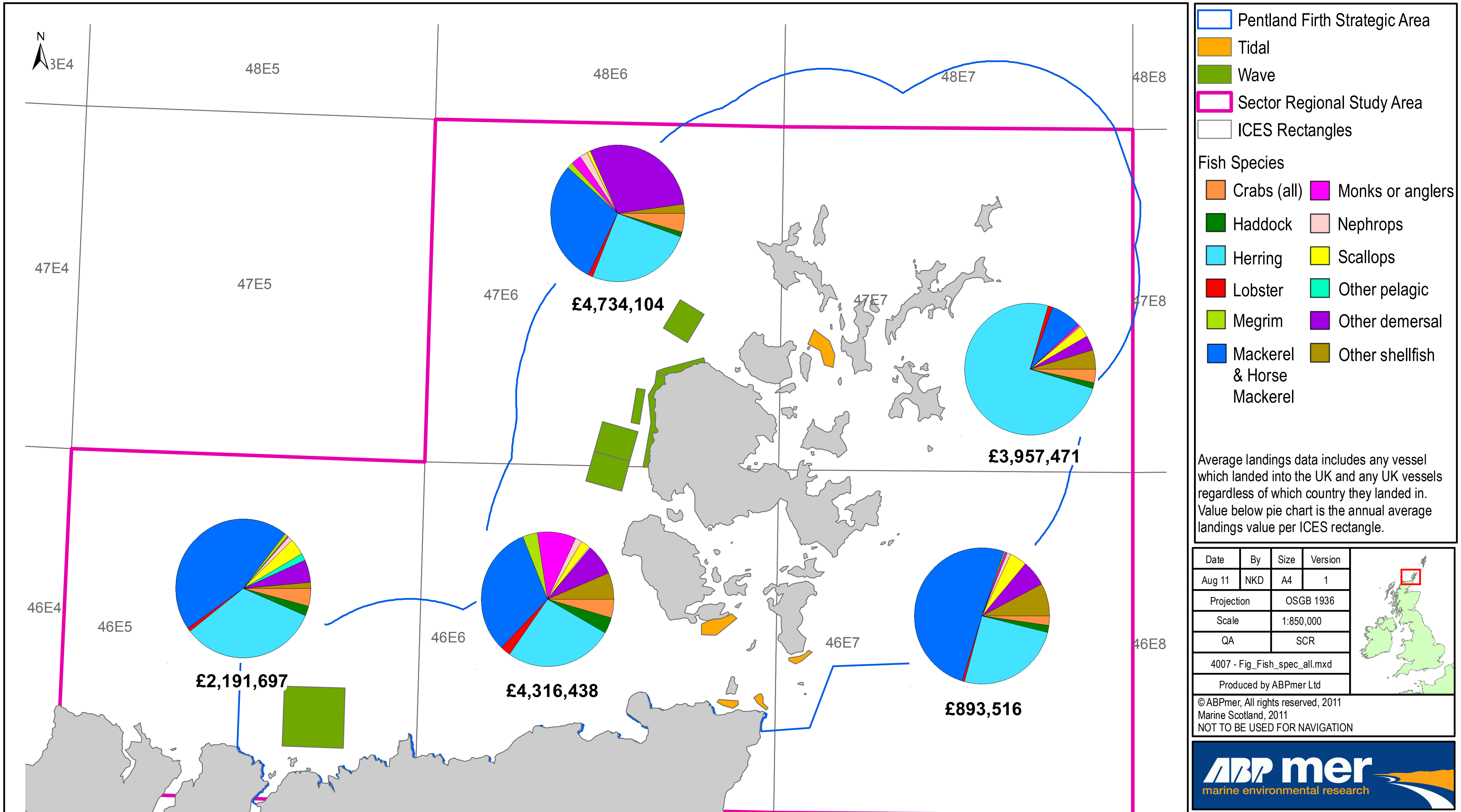
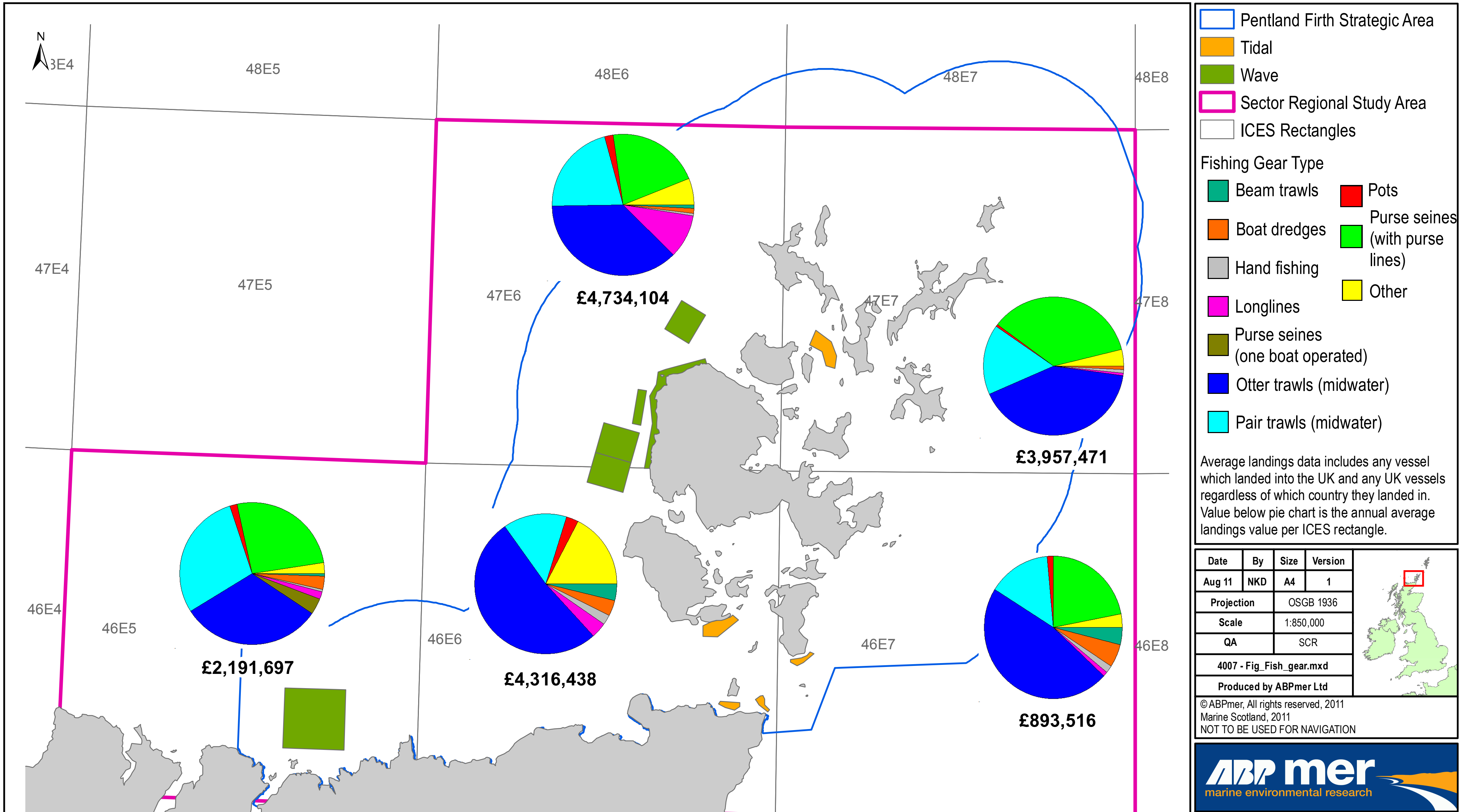
Appendix B. Additional Figures





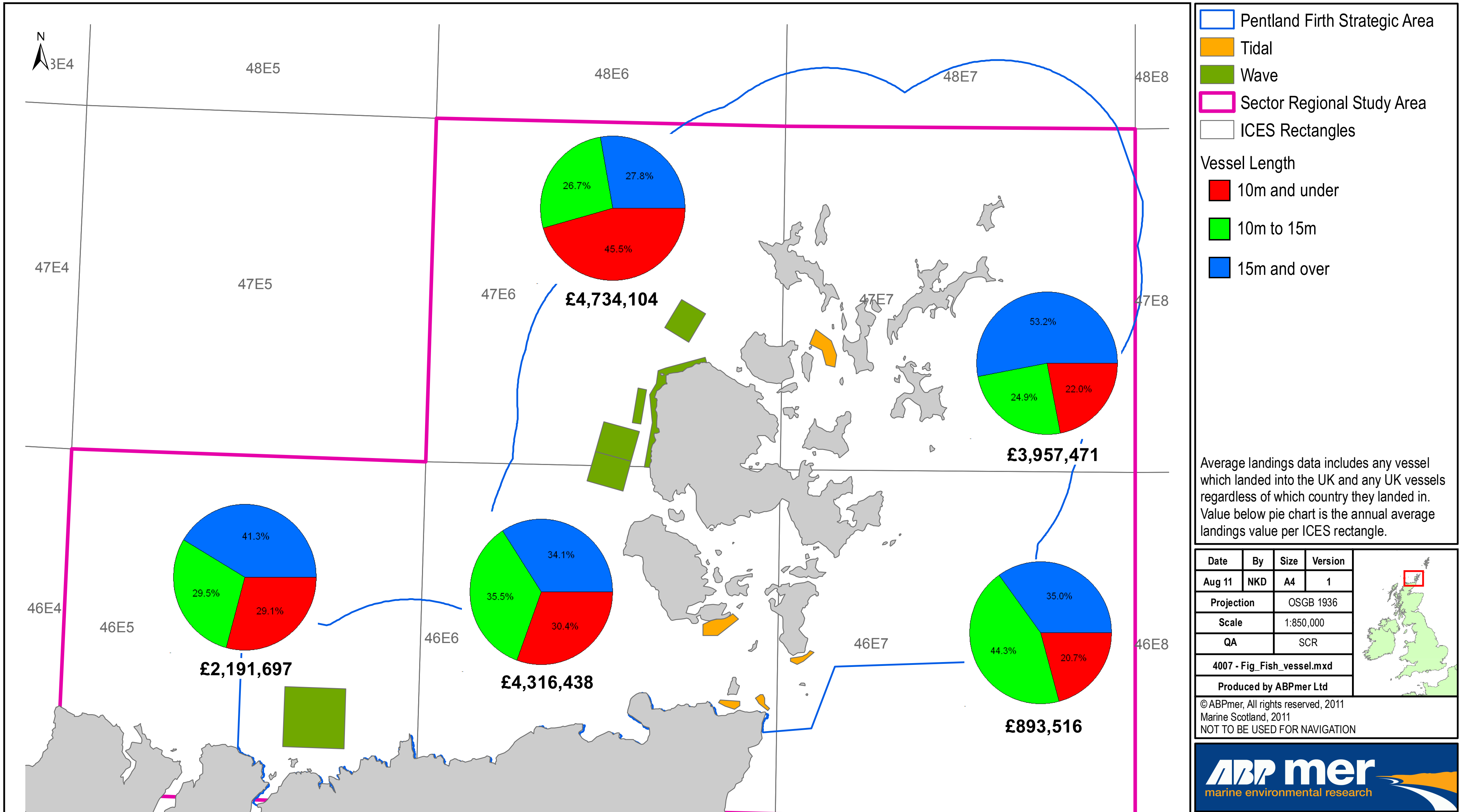
Relative Value of Landings by Species in the Study Area (Average 2000 - 2010)

Figure B2



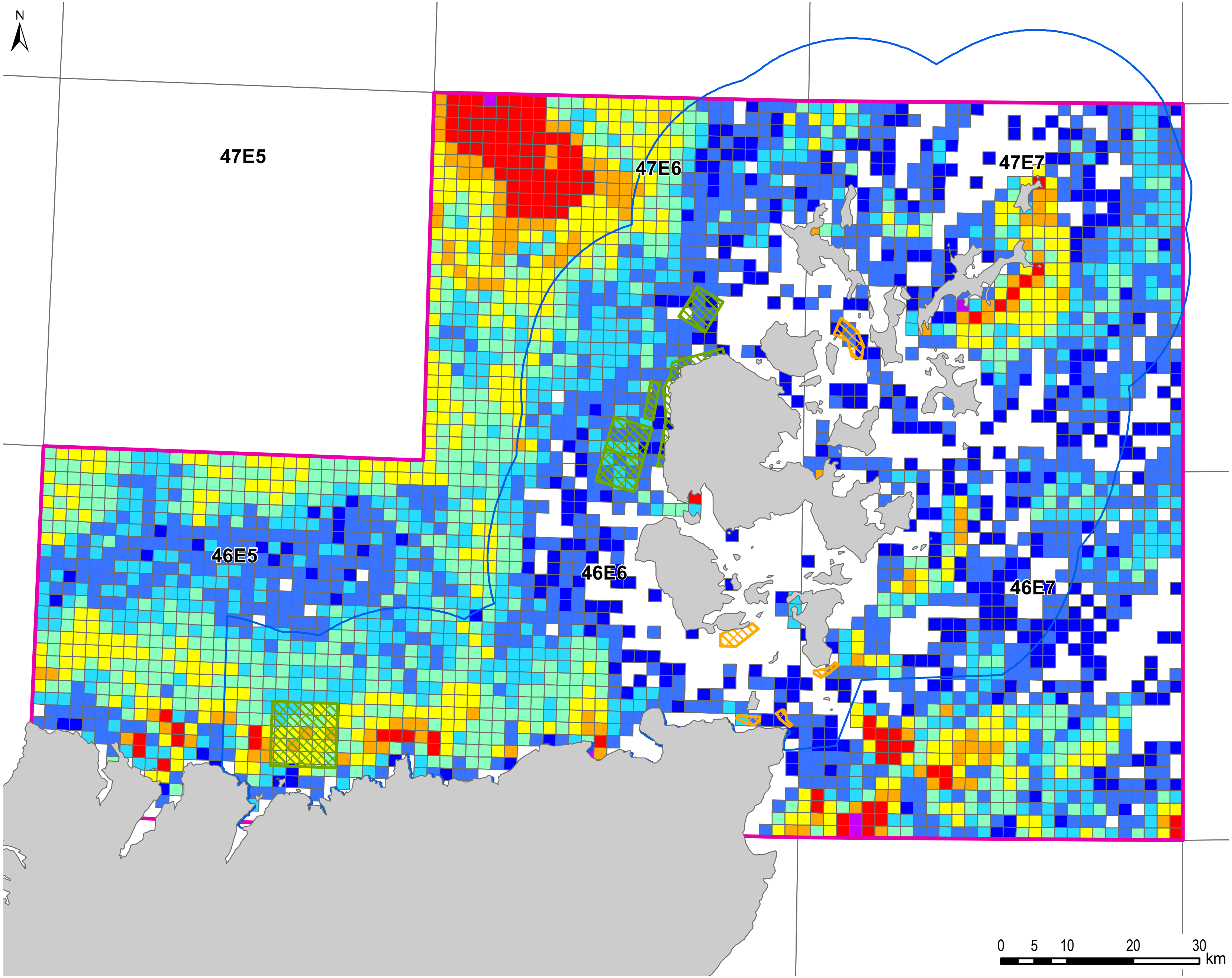
Relative Value of Landings by Fishing Gear Type in the Study Area (Average 2000 - 2010)

Figure B3



Relative Value of Landings by Fishing Vessel Length in the Study Area (Average 2000 - 2010)

Figure B4



Pentland Firth Strategic Area
Tidal
Wave
Sector Regional Study Area
ICES Rectangles

VMS Density
(Vessel Positions 2006 - 2010)

No. of VMS Pings
- 1
- 2 to 5
- 6 to 10
- 11 to 20
- 21 to 50
- 51 to 100
- 101 to 500
- More than 500

VMS data includes all vessel "pings" where the average speed since the last ping was over zero and under 5 knots.

Date	By	Size	Version
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Projection		OSGB 1936	
Scale		1:850,000	
QA		SCR	
4007 - Fig_Fish_VMS.mxd			
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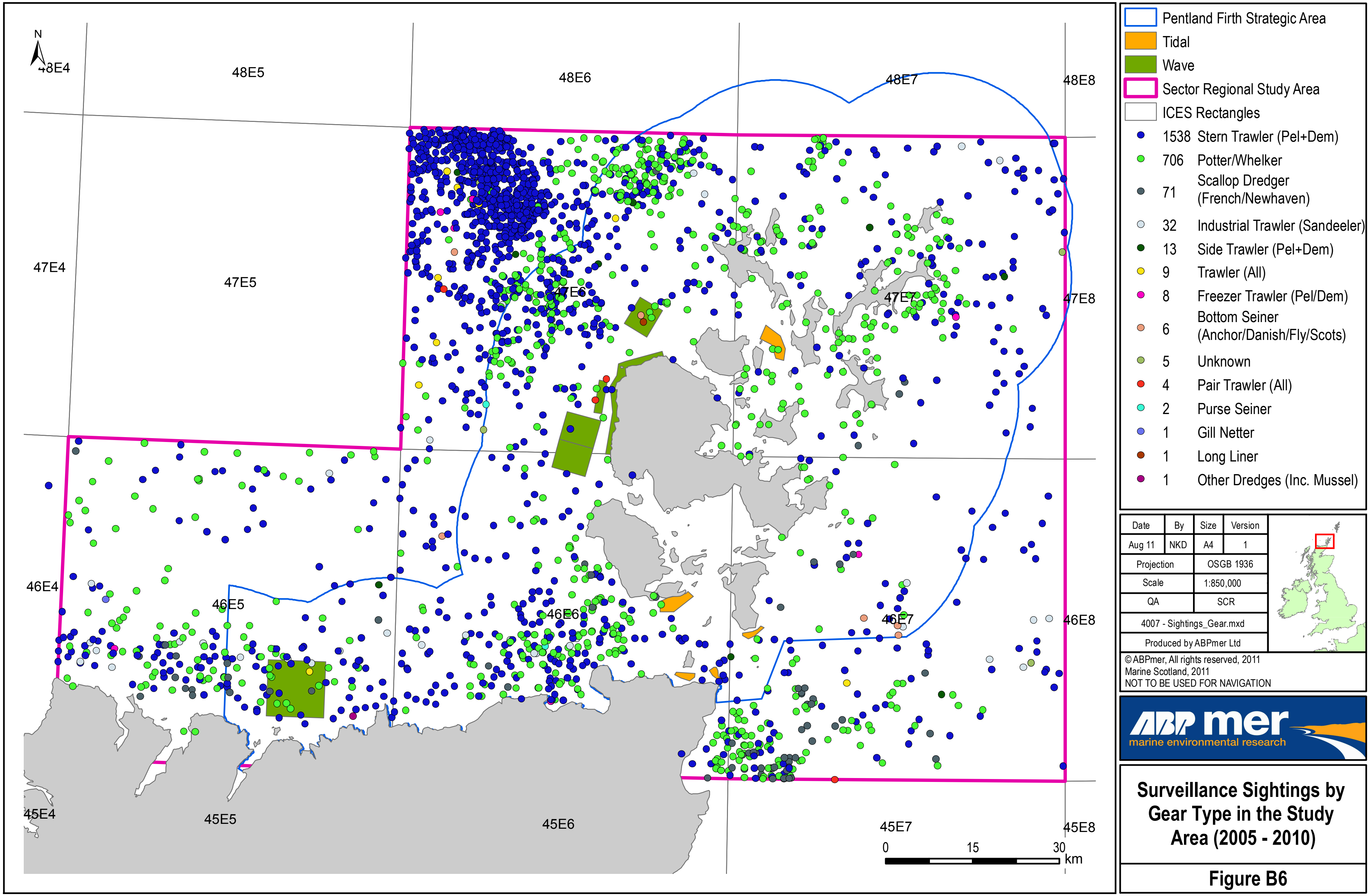
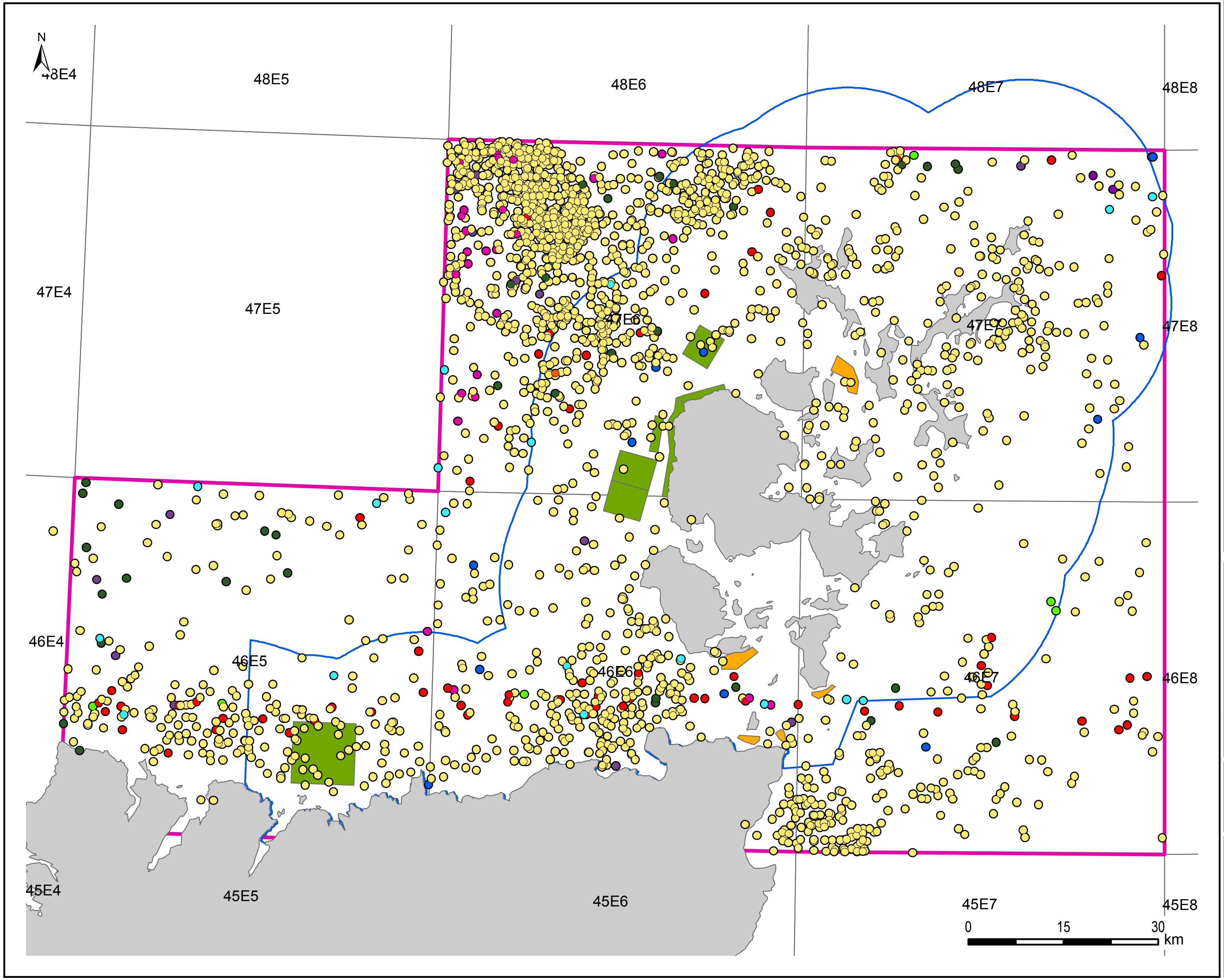
Satellite (VMS) Density of All UK Vessels over 15m (2006 - 2010)

Figure B5



Surveillance Sightings by Gear Type in the Study Area (2005 - 2010)

Figure B6



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QA		FMM	
4007 - Sightings_Nat.mxd			
Produced by ABPmer Ltd			

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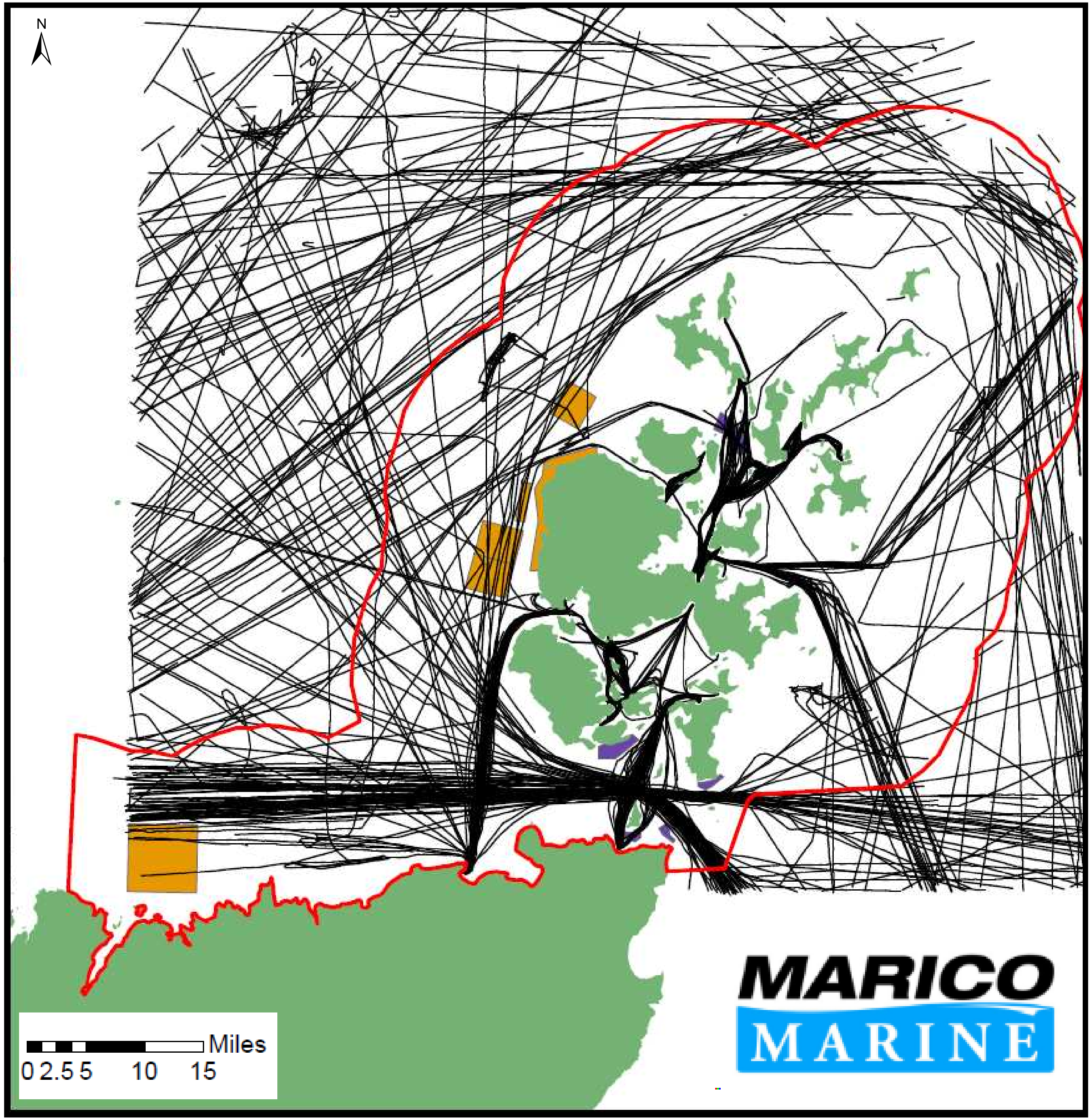
Surveillance Sightings by Nationality in the Study Area (2005 - 2010)

Figure B7



Pentland Firth Strategic Area
Ship Tracks
Tidal Sites
Wave Sites

Adapted from Marico Marine
Figure: 11UK812/Map5

Date	By	Size	Version
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QA	Draft		
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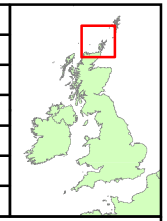
Produced by ABPmer Ltd			



Data Source: Marico marine. AIS Data 23rd October 2009 to 5th November 2009

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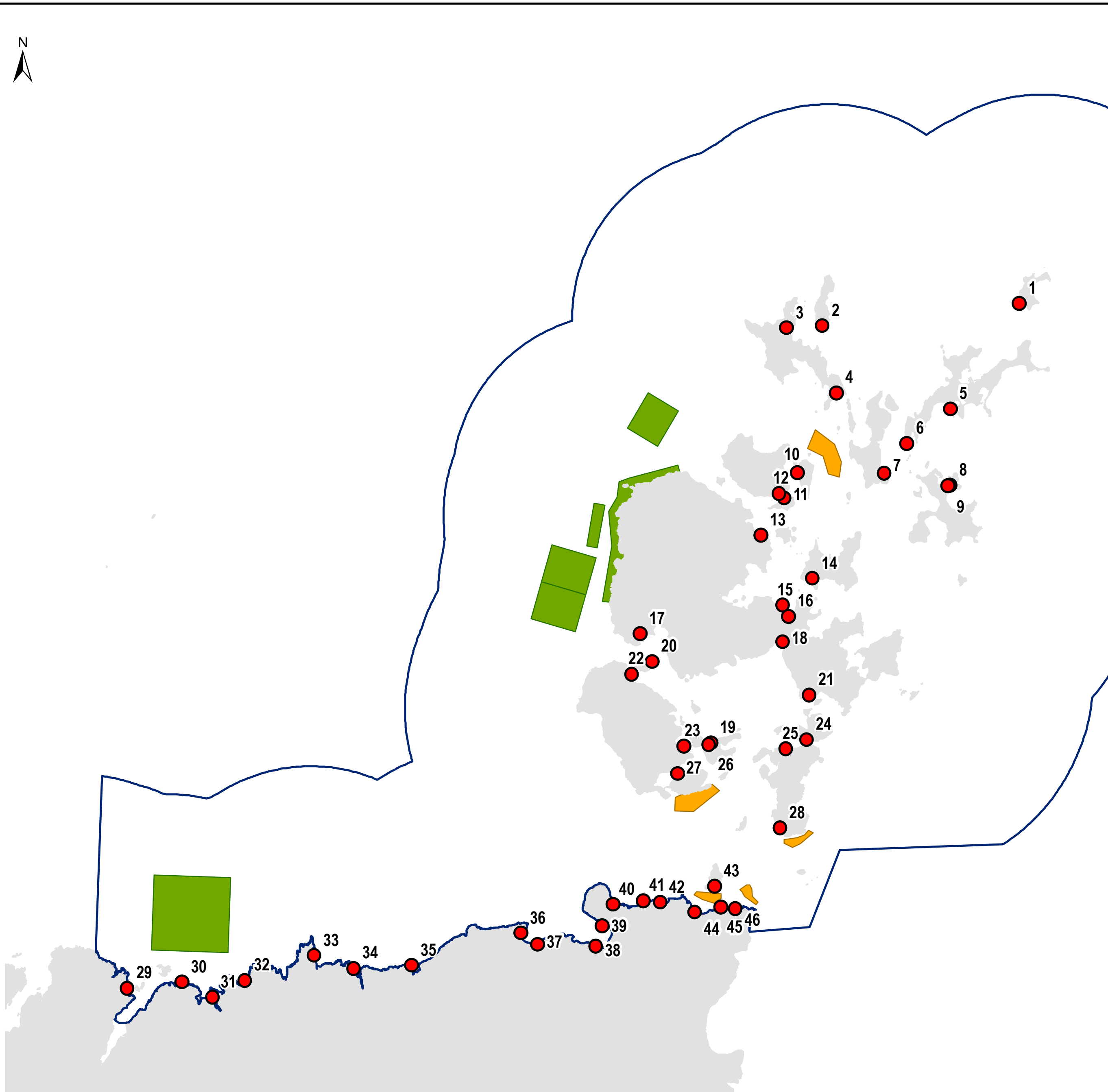
AIS Data for 23rd Oct 2009 to 5th November 2009 in the Study Area

Figure B8



Port/Harbour	Number
Orkney	
Nouster (North Ronaldsay)	1
Moclett (Papa Westray)	2
Pierowall (Westray)	3
Rapness (Westray)	4
Kettletoft (Sanday)	5
Loth (Sanday)	6
Backaland (Eday)	7
Whitehall Ferry Terminal	8
Stronsay West Pier	9
Egilsay	10
Wyre	11
Rousay	12
Tingwall	13
Balfour (Shapinsay)	14
Kirkwall - Hatston Pier	15
Kirkwall	16
Stromness	17
Scapa	18
Flotta - Sutherland Pier	19
Graemsay	20
Holm	21
Moaness (Hoy)	22
Lyness (Hoy)	23
Burray	24
St Margaret's Hope	25
Flotta - Sutherland Pier	26
Longhope (Hoy)	27
Burwick (South Ronaldsay)	28
Scottish Mainland	
Talmine	29
Skerray	30
Bettyhill	31
Kirtomy	32
Port Grant (Strathy Head)	33
Portskerra	34
Sandside	35
Scrabster	36
Thurso	37
Castlehill	38
Dwarwick	39
Brough	40
Scarfskerry	41
Harrow	42
Stroma	43
Gill's Bay	44
Huna	45
John O'Groats	46

0 5 10 20 km

Port Locations
Pentland Firth Strategic Area
Tidal
Wave

Date	By	Size	Version
Aug 11	FMM	A4	1
Projection	OSGB 1936		
Scale	1:800,000		
QA	Draft		
4007 - Fig_Port_locations.mxd			
Produced by ABPmer Ltd			

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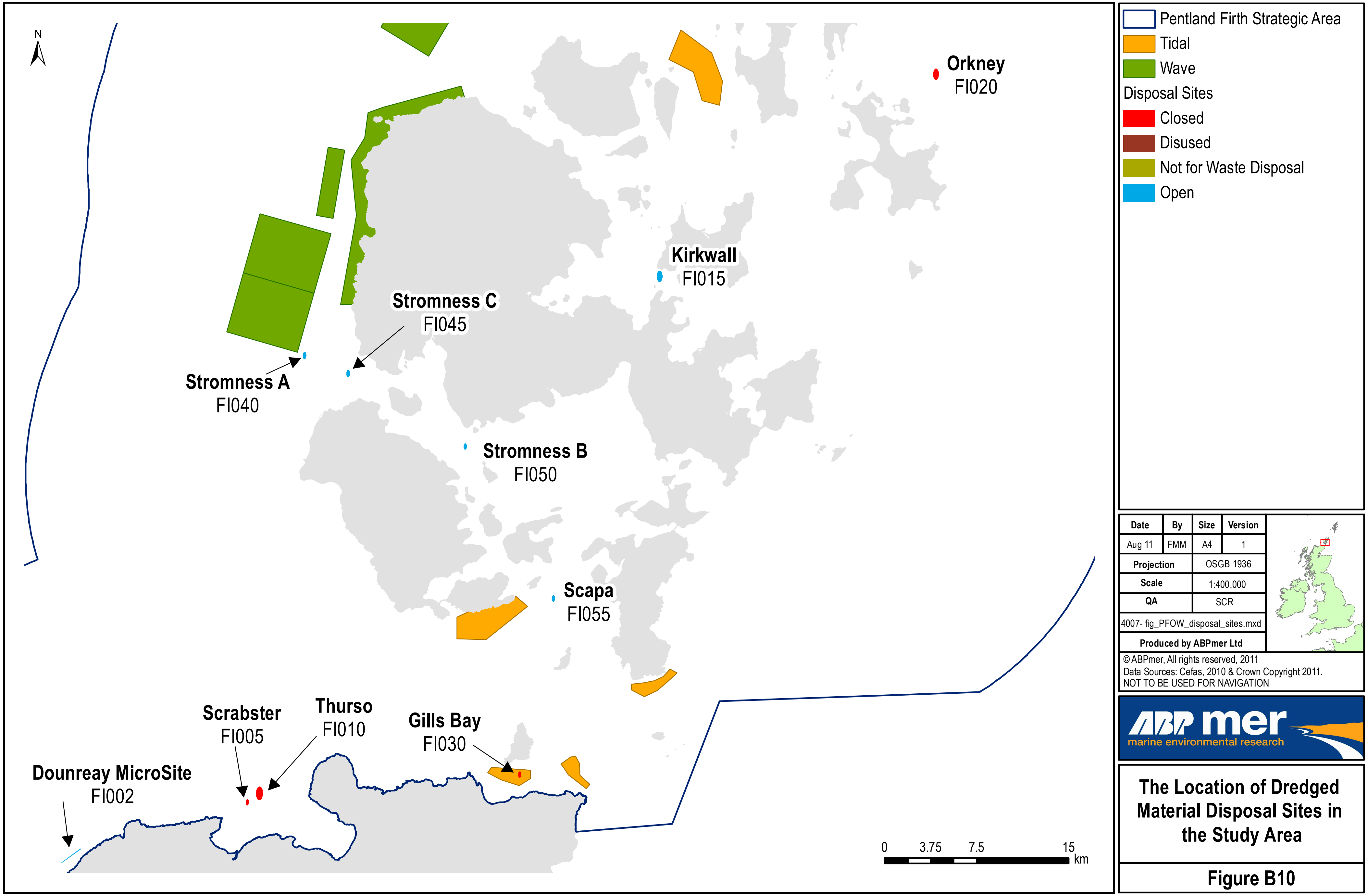
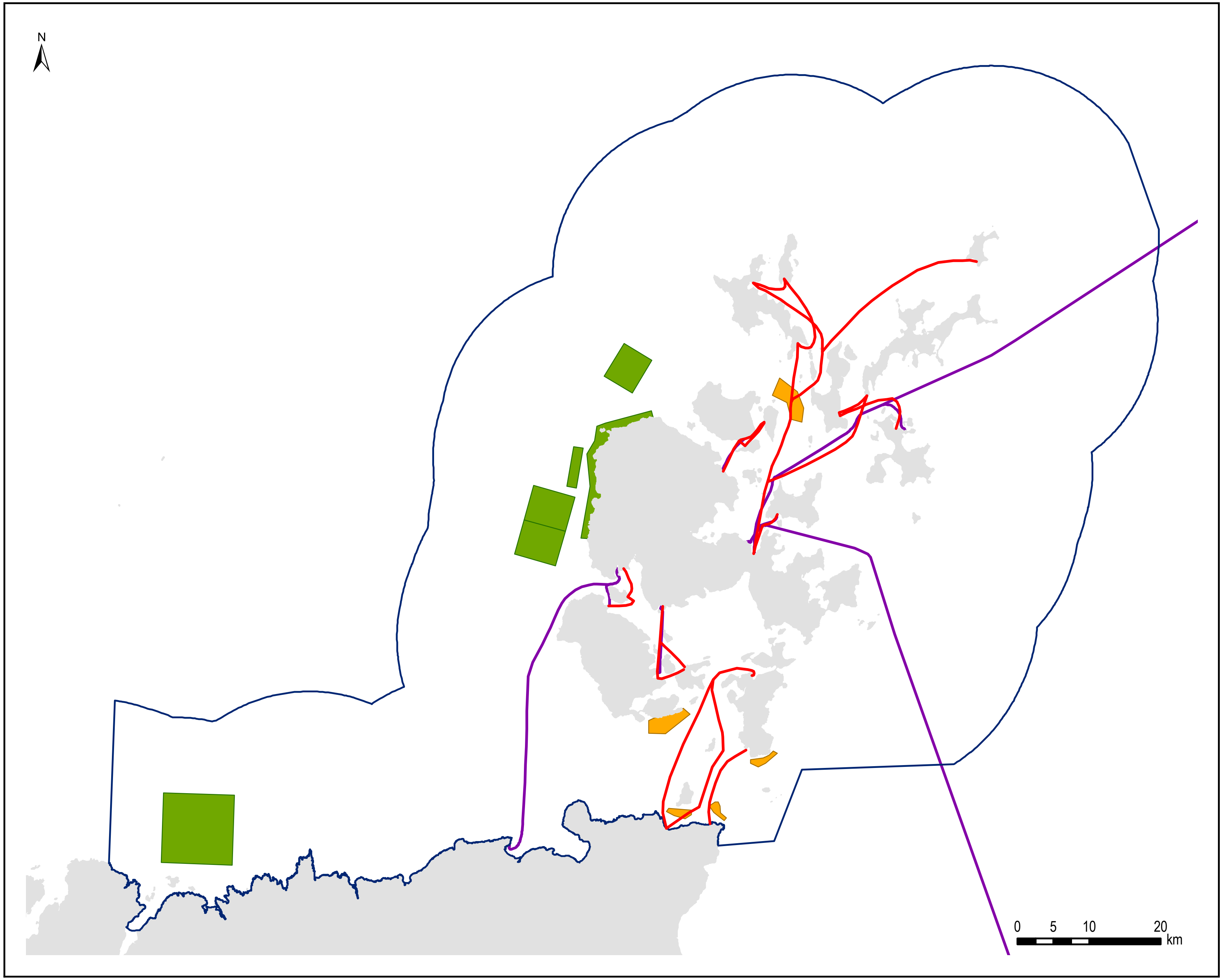
The Location of Ports in the Study Area

Figure B9



The Location of Dredged Material Disposal Sites in the Study Area

Figure B10



- Pentland Firth Strategic Area
- Tidal
- Wave
- Scottish 2010 Ferry Routes
- Orkney Internal Ferry Routes

Date	By	Size	Version
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Scale		1:750,000	
QA		SCR	

4007 - Fig_Ferry_Routes.mxd

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Data Sources: Orkneys Island Council, 2010 & Crown Copyright 2010.

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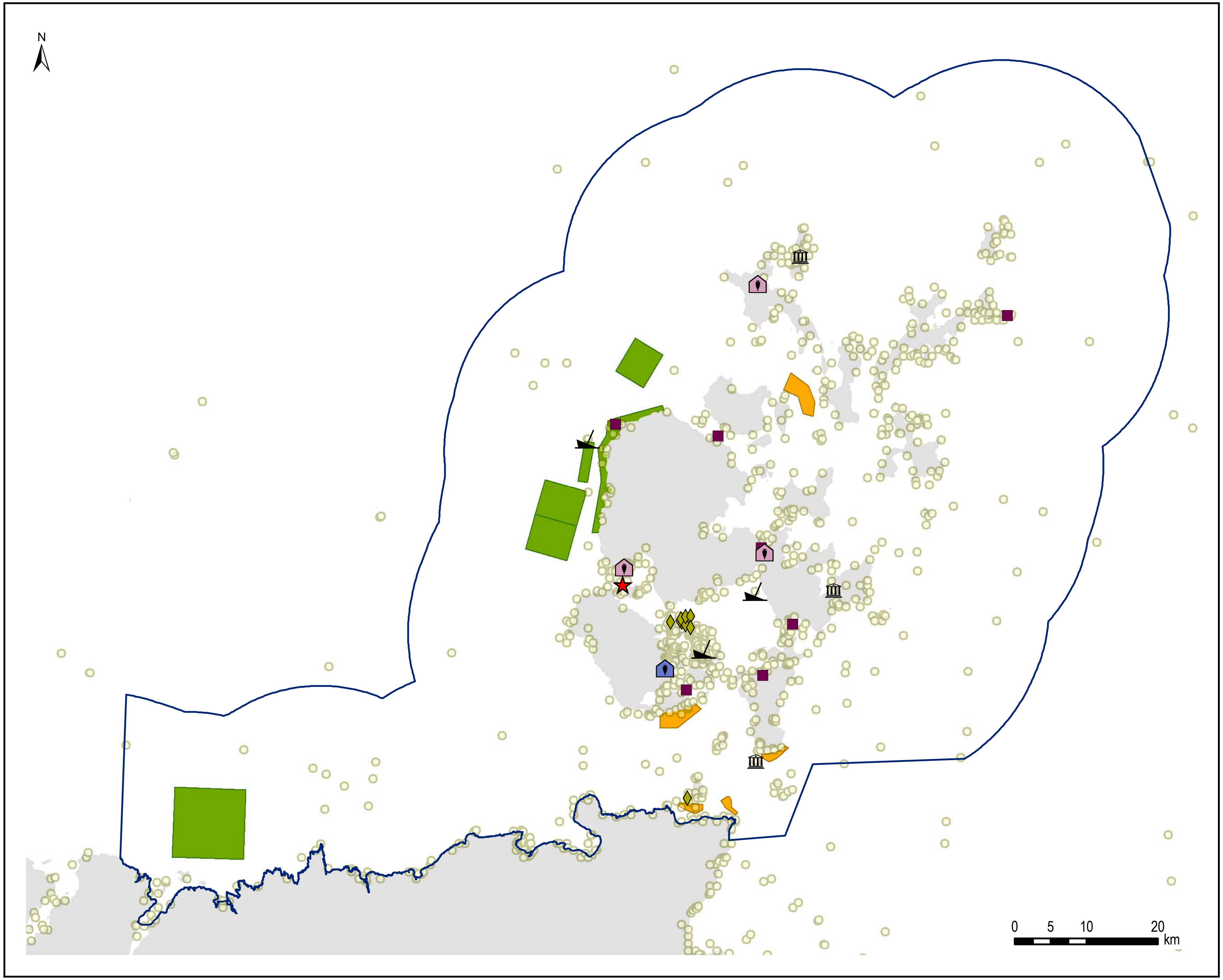
Ferry Routes in the Study Area

Figure B11



Pentland Firth Strategic Area
Tidal
Wave
All Heritage Assets
Managed Heritage Assets
Accessible Heritage Asset
Coastal Heritage Museum
Listed Building
Maritime Museum
Protection of Military Remains Act, 1986
Scheduled Ancient Monument - Ship Wrecks
World Heritage Site

Date	By	Size	Version
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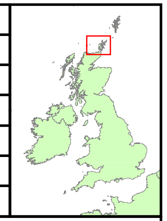

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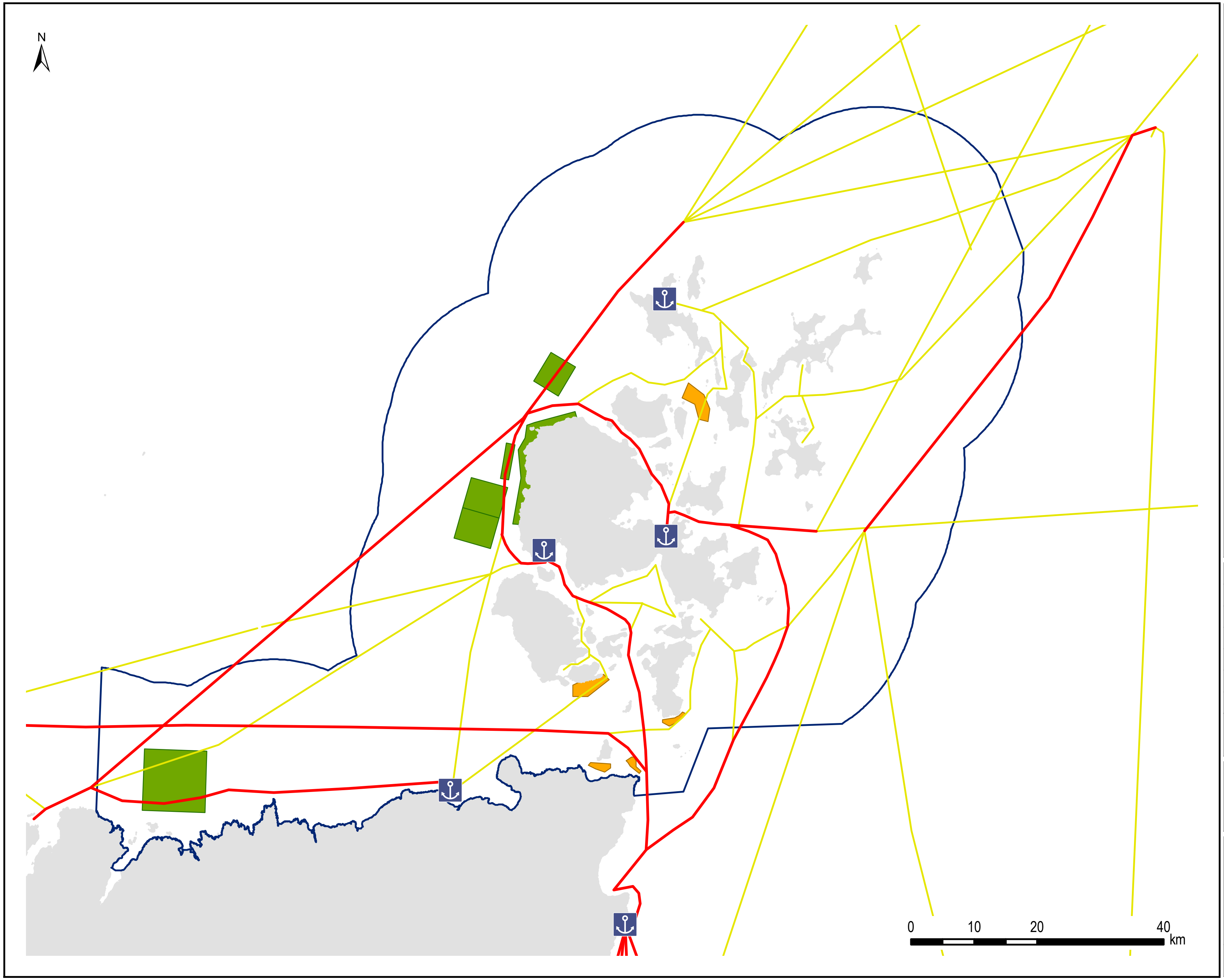
Marine and Coastal Heritage Assets in the Study Area

Figure B12



- Pentland Firth Strategic Area
- Tidal
- Wave
- Marinas
- RYA Medium Recreational Cruising Routes
- RYA Light Recreational Cruising Routes

Date	By	Size	Version
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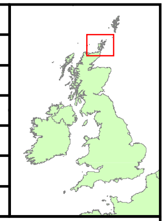
Scale		1:850,000	
QA		SCR	

4007 - Fig_rec_boating.mxd

Produced by ABPmer Ltd

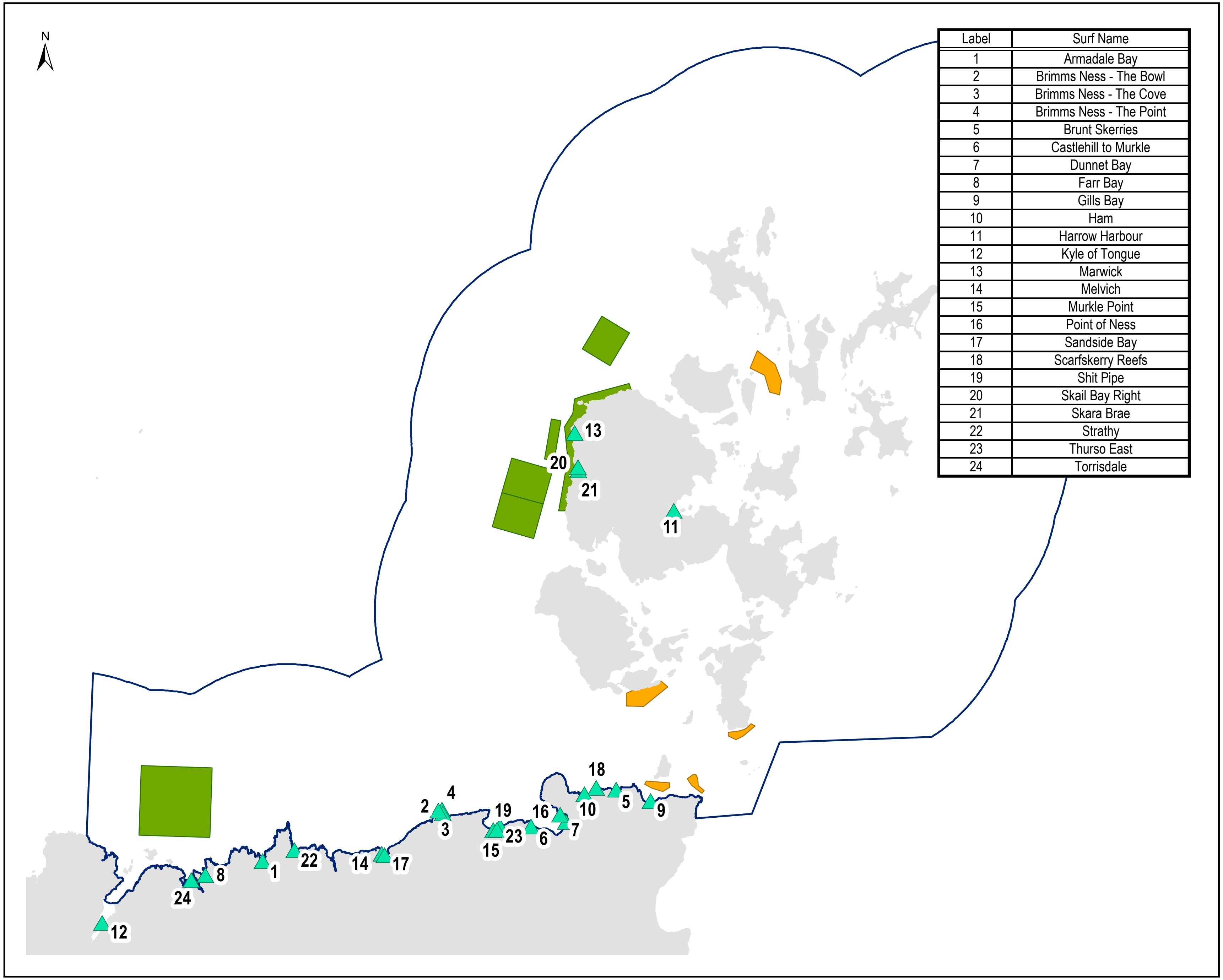


Data Sources The Crown Estate 2011 & Baxter 2011
NOT TO BE USED FOR NAVIGATION

ABP mer marine environmental research

RYA Cruising and Sailing Routes in the Study Area

Figure B13



Label	Surf Name
1	Armadale Bay
2	Brimms Ness - The Bowl
3	Brimms Ness - The Cove
4	Brimms Ness - The Point
5	Brunt Skerries
6	Castlehill to Murkle
7	Dunnet Bay
8	Farr Bay
9	Gills Bay
10	Ham
11	Harrow Harbour
12	Kyle of Tongue
13	Marwick
14	Melvich
15	Murkle Point
16	Point of Ness
17	Sandside Bay
18	Scarfskerry Reefs
19	Shit Pipe
20	Skail Bay Right
21	Skara Brae
22	Strathy
23	Thurso East
24	Torrisdale

Surfing Beaches
Pentland Firth Strategic Area
Tidal
Wave

Date	By	Size	Version
Aug 11	FMM	A4	1
Projection		OSGB 1936	
Scale		1:750,000	
QA		SCR	

4007 - Fig_Surfing_beaches.mxd

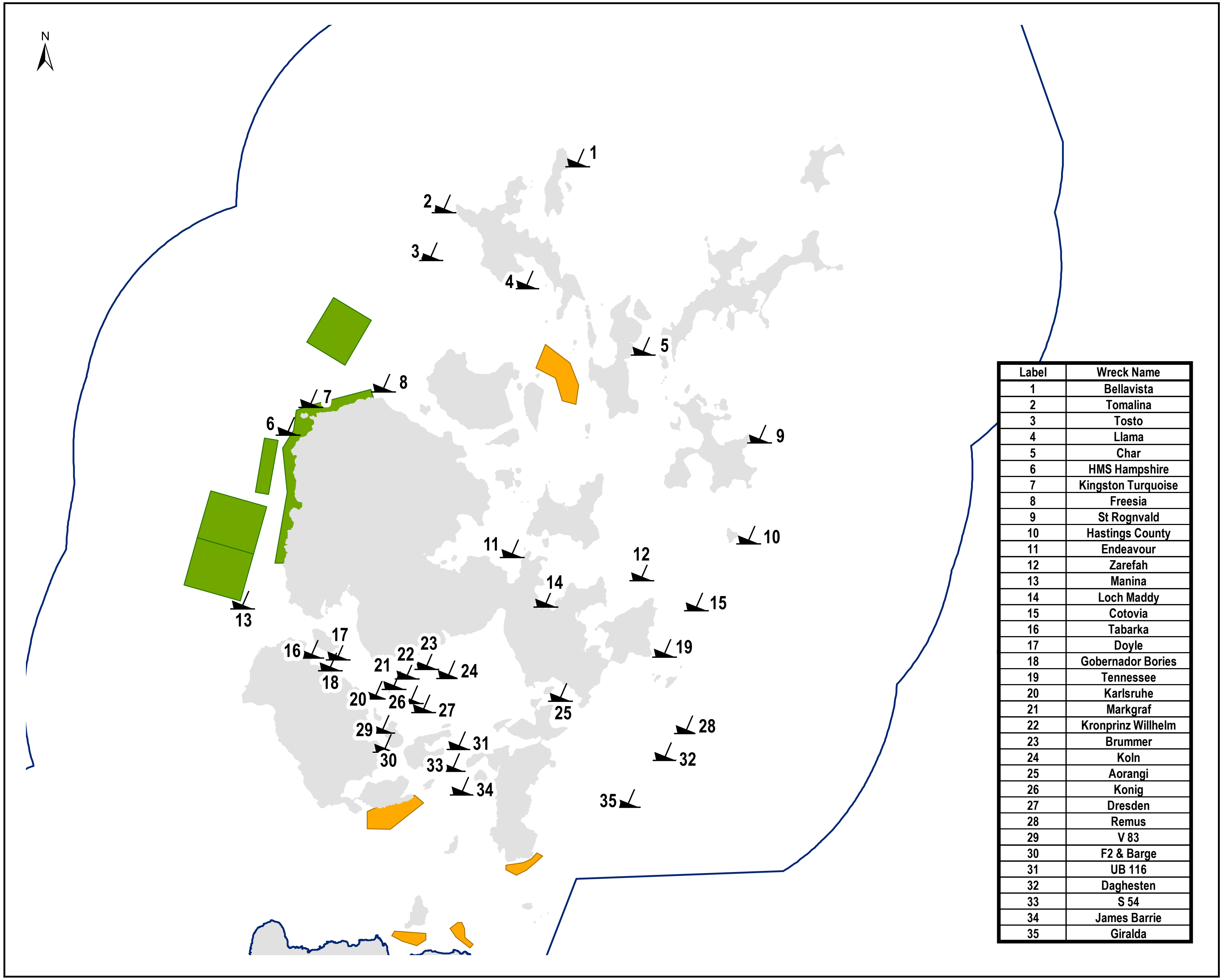
Produced by ABPmer Ltd

Data Source: SAS, 2009
NOT TO BE USED FOR NAVIGATION

ABP mer marine environmental research

Surfing Beaches in the Study Area

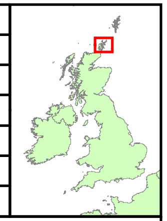
Figure B14



Label	Wreck Name
1	Bellavista
2	Tomalina
3	Tosto
4	Llama
5	Char
6	HMS Hampshire
7	Kingston Turquoise
8	Freesia
9	St Rognvald
10	Hastings County
11	Endeavour
12	Zarefah
13	Manina
14	Loch Maddy
15	Cotovia
16	Tabarka
17	Doyle
18	Gobernador Bories
19	Tennessee
20	Karlsruhe
21	Markgraf
22	Kronprinz Willhelm
23	Brummer
24	Koln
25	Aorangi
26	Konig
27	Dresden
28	Remus
29	V 83
30	F2 & Barge
31	UB 116
32	Daghesten
33	S 54
34	James Barrie
35	Giralda

Orkney Wreck Dive Sites
Pentland Firth Strategic Area
Tidal
Wave

Date	By	Size	Version
Aug 11	FMM	A4	1
Projection	OSGB 1936		
Scale	1:550,000		
QA	SCR		
4007 - Fig_Dive_sites.mxd			
Produced by ABPmer Ltd			

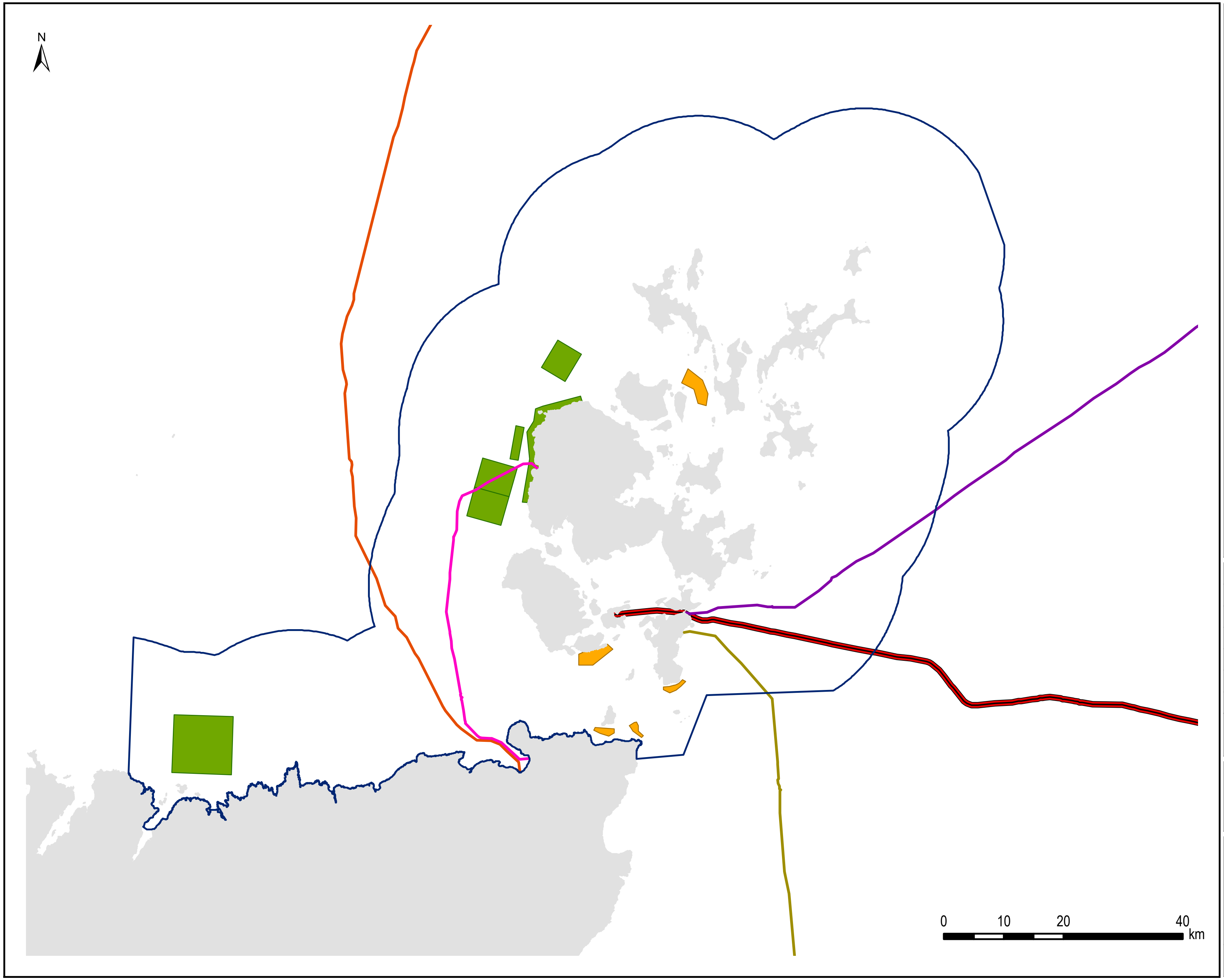


Data Source: The Crown Estate, 2011
NOT TO BE USED FOR NAVIGATION

ABP mer
marine environmental research

Popular Wreck Dive Sites within the Orkney Isles

Figure B15

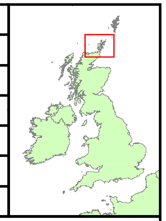


Pentland Firth Strategic Area
Tidal
Wave
Oil and Gas Pipelines

Telecommunication Cables

Shefa2 Segment 8
Shefa2 Segment 9
Northern Lights
Farice

Date	By	Size	Version
Aug 11	FMM	A4	1
Projection		OSGB 1936	
Scale		1:900,000	
QA		SCR	
4007 -Fig_Telecom_cables.mxd			
Produced by ABPmer Ltd			



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marine environmental research

Cables and Pipelines Intersecting the Study Area

Figure B16

Appendix C

Identifying Appropriate Assessment Methodologies and Tools

Appendix C. Identifying Common Assessment Methodologies

C1. Introduction

The purpose of the overall methodology is to provide a common approach to be adopted by each of the project developers when conducting socio-economic work as part of Environmental Impact Assessments.

This appendix describes suggested approaches for assessing potential socio-economic benefits and negative impacts that may arise as a result of PFOW projects both for individual projects and at a cumulative level (all PFOW projects). The approaches proposed seek to be proportionate both in terms of the taking account of the relative significance of the impacts and recognising the ease of data collection and availability to inform the assessments.

C2. Benefits

The following benefits are likely to arise as a result of PFOW projects:

- Investment in supply chain;
- Reductions in carbon emissions;
- Improvements to existing infrastructure, facilities and services;
- Benefits to other marine users and interests;
- Social benefits;
- Increases in knowledge as a result of research and development in wave and tidal technologies and from environmental surveys;
- Supply chain development/clustering increasing the UK's ability to service future domestic and international demand; and
- Improvements to energy security (depending on the mix of electricity generation displaced).

C2.1 Supply Chain Benefits

Substantial benefits will accrue to wave and tidal supply chains as a result of the estimated £6bn investment in PFOW projects. It is common practice to seek to assess such benefits in terms of changes in employment and Gross Value Added (GVA). For large scale economic assessments, these benefits are often assessed using a top-down approach taking account of planned expenditure and using (national) GVA effect and employment effect multipliers to estimate additional GVA and additional jobs created/supported. However, the top-down approach is difficult to apply at more regional or local levels because of significant uncertainties concerning the applicability of the national multipliers to local levels. For individual projects, it is often possible to adopt a bottom-up approach using developer information on the specific type and timing of supply chain expenditure and/or the proportion of expenditure that will be retained within the local/regional economy.

At the level of individual projects we therefore suggest that a bottom-up approach should be adopted to estimating changes in GVA and additional jobs created/supported, described below. However, in order to obtain estimates of the cumulative effect of PFOW projects we suggest that both bottom-up and top-down approaches are applied to provide estimates. Figure C1 provides an illustration of the top down and bottom-up methods. The proposed methodologies are described in more detail below.

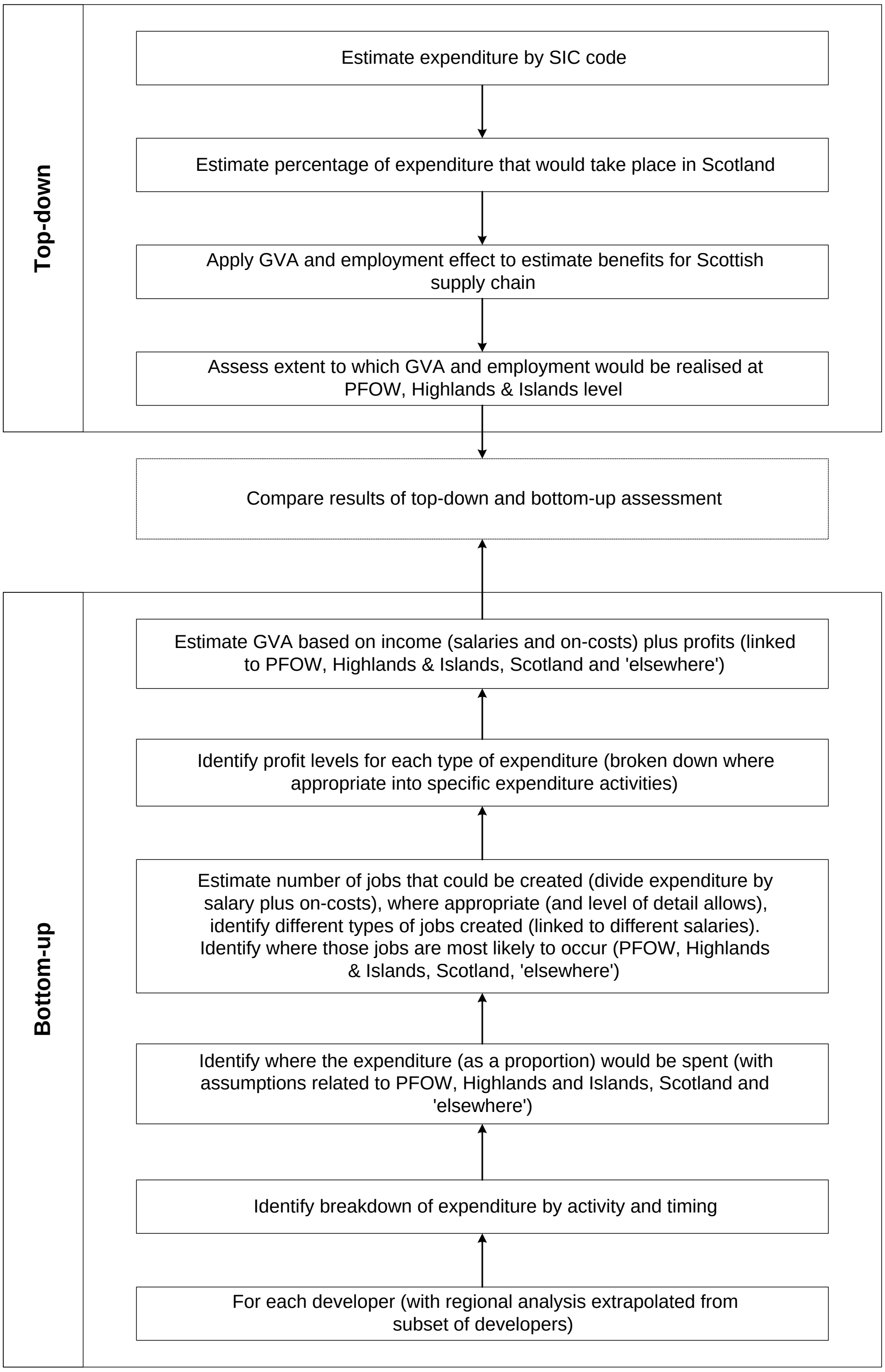

Figure C1. Suggested Approaches to Project (Bottom-up only) and Cumulative Assessments (Bottom-up and Top-down) Used

C.2.1.1 Assessment of individual projects

For individual PFOW projects, developers should have some information on the specific type and timing of supply chain expenditure and/or the proportion of expenditure that will be retained within the local economy. This information can be used to provide an assessment of expenditure to input to the methodology. Application of the methodology requires the following information:

- A breakdown of expenditure by activity and timing (industry benchmarks could be used as default data if this is not available). The types of expenditure to be considered are shown in Table C1;
- Where (as a proportion) the expenditure would be made, allocated between PFOW, Highlands & Islands, Scotland or 'elsewhere'. For example, this might include identification of which port would be used for construction and for operation & maintenance activities. There will need to be a focus on those activities that are longer term and are more likely to be located in the PFOW area (even if these are not the major areas of expenditure) as it is expenditure in the PFOW area that will drive the estimated benefits; and
- Profit levels for each type of expenditure (approximate).

In advance of application of the methodology, it is recommended that some initial testing is undertaken for one or two of the more advanced PFOW projects to refine the approach. For example, this should include discussion with developers to determine where aggregation of types of expenditure may be needed and/or if further sub-division may be required to enable projections of expenditure to be made.

Table C1. Types of Expenditure That Will Need to be Considered by Developers

Activity	Sub-Activity	Types of Expenditure
Development and consents	Design and feasibility	Development of device arrangements Grid connection feasibility Engineering design Marine logistics studies Development of contracting strategies Techno-economic analysis to determine expected costs and revenues
	Physical surveys	Geophysical surveys of sea bed and bathymetry Geotechnical surveys of sea bed characteristics
	Environmental surveys	Benthic surveys Fish (pelagic) surveys Marine mammal surveys Bird (ornithological) surveys Onshore surveys
	Meteorological and resource monitoring	Deploy of sensors Detailed modelling of wave and tidal resource characteristics
	Applications and consents	Completion and submission of environmental statement Application for an negotiation of electrical grid connection Stakeholder engagement and public relations
Device manufacturing	Hydrodynamic system	Design Procurement Precision fabrication
	Reaction system	
	Power take-off system	

Activity	Sub-Activity	Types of Expenditure
	Control system	Moulding and finishing Casting Assembly Provision of coatings Workshop testing and verification
Balance of plant manufacturing	Foundations and moorings	Large-scale concrete structure production Fabrication of steel frame structures Design of dynamic structures Corrosion and marine growth prevention products
	Cabling	Large scale and high precision cabling extrusion and assembly Insulation of cables for thermal and electrical protection Cable armouring products Electrical design
	Electrical equipment	Design Manufacturing and development
	Onshore infrastructure	Procurement of appropriate buildings, control centres, offices Storage (prior to installation and/or spare parts)
Installation	Port services	Storage Final assembly Dry (and possibly) wet commissioning of electrical parts Support vessels and personnel
	Installation of foundations and moorings	Procurement of specialist and support vessels Specialist installation
	Installation of electrical systems	Directional drilling Draw-through and installation of subsea cabling Cable protection and securing Installation and connection to offshore substation Installation and connection of array cabling
	Installation of marine energy device	Electrical energisation Safety checks Operational checks Early monitoring
Operation and maintenance	Operations	Monitoring (performance, environmental impact) Planning and management of maintenance
	Maintenance	Replacement of components Refurbishment Reactive maintenance
	Grid charges	Access and use of electrical distribution and transmission networks
	Insurance	Covering risks related to ongoing operation
	Land-related	Onshore and offshore leases

(Source: Based on BVG Associates (2011):

The information on expenditure will enable the number of jobs that could be created to be estimated. Table C2 provides an indication of the types of jobs that will need to be considered. The Table shows job type based on two sources; discussions will be required with developers to reach an agreed classification of job types. The estimate will be made by dividing the expenditure allocated to each activity (over time) by the salary plus on-costs. The appropriate salary and on-costs to use will be determined by considering different types of jobs (managerial, skilled, non-skilled, etc.) and the range of salaries and on-costs that these attract. The identification by developers of where different types of expenditure are likely to be spent will allow the location of those jobs created (or existing jobs supported) to be identified.

Table C2. Type of Jobs to be Considered in the Assessment

Based on NOMIS Data	Based on Approach Similar to Snedden Economics (2005)
Managers and senior officials	Management
Administrative and secretarial occupations	Administration
Professional occupations Associated professions and technical occupations	Technical/Engineering
Process, plant and machine operatives	Skilled trades
Personal service occupations Sales and customer service operations Elementary occupations	Semi-skilled trades
Notes: The comparison between job types based on NOMIS and Snedden Economics (2005) will need to be discussed and agreed with the developers	

GVA benefits can then be estimated by using profit levels estimated by developers for each type of expenditure and the additional income (salaries plus on-costs). The timing of expenditure can be used to estimate when the GVA benefits will accrue. This will allow the NPV of the GVA benefits to be estimated[8] if required.

Discussions with two developers will be used to provide illustrative examples of application of the methodology. This approach can then be followed by developers in their own project assessments, where they can input their own information on the breakdown of expenditure, allocation of expenditure and profit levels to enable specific benefits to be estimated for their project.

C.2.1.2 Cumulative assessment

The bottom-up approach to estimating GVA and employment for individual projects necessarily requires a large number of assumptions to be made. While it is possible to extrapolate from selected individual projects to estimate GVA and employment for PFOW projects as a whole, there will be a significant uncertainty in this estimate. In particular, the bottom-up approach will not capture any knock-on (indirect) effects from the additional expenditure without reference to existing input-output tables (which are only available for Scotland as a whole at two digit SIC codes, hence, are not specific to the PFOW area). In addition, it will not be possible to generate an assessment of the overall number of jobs created through PFOW projects without extrapolating across the number of projects (assuming that the other projects would have similar breakdowns in terms of expenditure and location of that expenditure). For these reasons, it is proposed that the assessment also uses a top-down approach when seeking to estimate the cumulative employment and GVA effects associated with the PFOW projects. This will give two estimates of the cumulative benefits: the top-down approach is more likely to result in an over-estimate while the bottom-up approach will most probably give an under-estimate. Comparison of the results of the two approaches, with discussion on the sources and extent of uncertainty within them, may be useful in attempting to identify a reasonable overall estimate of the potential regional employment and GVA benefits.

8 It is important to note when considering profits as estimated by developers that they could benefit by suggesting lower levels of profit than might actually occur (to encourage public sector investment). However, lower levels of profit will result in lower NPV benefits, which could discourage public sector investment.

For the bottom-up approach to assessing cumulative effects, information from the two PFOW projects assessed to test the bottom-up methodology will simply be extrapolated to cover all PFOW projects, principally based on generating capacity.

In the top-down approach, benefits to the supply chain will be estimated by multiplying the expenditure associated with specific wave and tidal energy activities by the GVA effect and employment effect multipliers. This gives an estimate of the additional GVA generated and additional jobs created/supported as a result of the increased expenditure. To do this requires the following steps:

1. Identify the specific activities and expenditure associated with those activities;
2. Link those activities to SIC codes;
3. Link the SIC codes to GVA effect and employment effect multipliers; and
4. Multiply expenditure by the appropriate GVA effect and employment effect multipliers.

However, there are issues with data consistency and availability that need to be addressed, as well as issues associated with impacts at the national versus local level. The following text discusses how these issues could affect what can be achieved during the assessment.

To apply a top-down approach many assumptions need to be made and there are issues with data consistency and availability that need to be addressed. It is important to note, therefore, that the top-down approach will be used to provide an indication of the potential GVA and employment benefits for the PFOW projects as a whole. As noted above, the bottom-up approach should provide more reliable estimates, as it will be better able to capture the niche activities associated with wave and tidal projects which are more likely to be sourced from outside the area than more generic activities.

It will be important to assess the timing of expenditure and, hence, when the benefits might be expected to occur. This will enable the Net Present Value (NPV) to be calculated for the GVA benefits.

Identify the Specific Activities and Expenditure Associated with Those Activities

BVG Associates (2011) provides a detailed breakdown of the activities associated with wave and tidal energy. Information on the activities, sub-activities and expenditure associated with them will be used as the starting point. BVG Associates (2011) provides a very detailed breakdown of activities and sub-activities, which may not be possible to retain throughout the analysis. The remainder of this section describes how and where some detail may be lost due to data availability and consistency issues.

Linking Activities to SIC Codes

Table C3 shows the activities and sub-activities taken from BVG Associates (2011). The table then links the sub-activities to possible SIC codes. The detailed explanatory notes in Office for National Statistics have been used to identify the 'most appropriate SIC code for each activity. In some cases, more than one code is given to reflect the variety within the sub-activities (as given in the descriptions in BVG Associates, 2011). Detailed codes (e.g. four digit codes) are provided where these best align with the description of the sub-activities; less detailed (two and three digit codes) are used where a more accurate description of the activities is not available.

Some of the sub-activities are difficult to assign to particular SIC codes. In many cases, the detailed and specific sub-activities described in BVG Associates (2011) do not map well onto the SIC codes, which tend to be much more generalised in their descriptions. The result is that some of the detailed and specific nature of the activities described in BVG Associates (2011) is lost as the analysis proceeds, with a move towards more generic activities in the economic data. However, in most cases the fit with the four digit SIC codes is reasonable.

Table C3. Linking Supply Chain Activities to SIC Codes

Activity[1]	Sub-Activity[1]	Possible SIC Code[2]
Development and consents	Applications and consents	Other professional, scientific and technical activities n.e.c (74.9) General public administration activities (84.11)
	Meteorological and resource monitoring	Other professions, scientific and technical activities n.e.c (74.9)
	Environmental surveys	Other professions, scientific and technical activities n.e.c (74.9)
	Physical surveys	Engineering related scientific and technical consulting services (71.12/2)
	Design and feasibility	Engineering design activities and related technical consultancy (71.12)
Device manufacturing	Control system	Manufacture of electronic industrial process control equipment (26.51/2)
	Power take-off system	Manufacture of general purpose machinery (28.1)
	Reaction system	Manufacture of other fabricated metal products (25.9)
	Hydrodynamic system	Manufacture of other fabricated metal products (25.9)
Balance of plant manufacturing	Onshore infrastructure	Renting and leasing of other machinery, equipment and tangible goods n.e.c (77.39) Project management activities related to civil engineering works (71.12)
	Electrical equipment	Manufacture of electronic components (26.11)
	Cabling	Manufacture of other electronic and electric wires and cables (27.32)
	Foundations and moorings	Manufacture of articles of concrete, cement and plaster (23.6) Manufacture of structured metal products (25.1)
Installation	Installation of marine energy device	Installation of industrial machinery and equipment (33.2)
	Installation of foundations and moorings	Specialised construction activities (43)
	Installation of electrical systems	Installation of industrial machinery and equipment (33.2) Construction of communications and port transmission lines (42.22)
	Port services	Service activities incidental to water transport (52.22) Sea and coastal freight water transport (50.2)
Operation and maintenance	Land-related	Renting and leasing of other machinery, equipment and tangible goods n.e.c (77.39)
	Insurance	Insurance (65.1)
	Grid charges	Trade of electricity (35.14)
	Maintenance	Repair of fabricated metal products, machinery and equipment (33.1)
	Operation	Project management activities related to civil engineering works (71.12)

Notes:
1 Based on BVG Associates (2011): **Wave and Tidal Energy in the Pentland Firth and Orkney Waters: How the Projects Could be Built**, report commissioned by the Crown Estate, May 2011.
2 Based on the SIC 2007 codes as these are the ones used for the input-output multipliers (Office for National Statistics (2009): **UK Standard Industrial Classification of Economic Activities 2007** (SIC 2007), Structure and Explanatory Notes, Cardiff.

Linking the SIC Codes to GVA Effect and Employment Effect Multipliers

Table C4 shows how the sub-activities and SIC codes identified above map onto the available input-output multipliers for Scotland (2007). The table shows that there is a lack of detailed multiplier information so it is necessary to look for the closest match (usually the higher level, two-digit SIC code). This means that the GVA and employment effect multipliers will be much more general than the more specific activities suggested by the SIC codes. Again, this results in a loss of detail, pushing the assessment towards a more generic outcome. This will affect the reliability of the results as they will be linked to much more general economic activities and will not fully reflect the specialised nature of the tasks that are required when developing, constructing, installing and maintaining the wave and tidal energy projects. It is likely that the specialised nature of the activities associated with wave and tidal projects will require more services to be sourced from outside PFOW and Scotland than would be suggested from the multiplier data, such that the benefits may be over-estimated by the top-down approach. It will be important to consider the impacts of this uncertainty on the estimated supply chain benefits for Scotland before undertaking the final stage in the top-down methodology, to assess the extent to which GVA and employment would be realised at PFOW, Highlands & Islands level.

Table C4. Linking Supply Chain Activities to SIC Code Multipliers

Sub-Activity[1]	Possible SIC Code[2]	Best Fit SIC Code with Multiplier[3]	Comments
Applications and consents	Other professional, scientific and technical activities n.e.c (74.9) General public administration activities (84.11)	Other business services (74) Public administration (84)	No multiplier for 74.9 No multiplier for 84 Use of two multipliers will mean expenditure has to be divided between them
Meteorological and resource monitoring	Other professions, scientific and technical activities n.e.c (74.9)	Other business services (74)	No multiplier for 74.9
Environmental surveys	Other professions, scientific and technical activities n.e.c (74.9)	Other business services (74)	No multiplier for 74.9
Physical surveys	Engineering related scientific and technical consulting services (71.12/2)	Architectural activities etc (71)	No multiplier for 71.12/2
Design and feasibility	Engineering design activities and related technical consultancy (71.12)	Architectural activities etc (71)	No multiplier for 71.12
Control system	Manufacture of electronic industrial process control equipment (26.51/2)	Electronic components (26.1)	No multiplier for 26.51/2 or for 26.5
Power take-off system	Manufacture of general purpose machinery (28.1)	General purpose machinery (28.1)	Multiplier available
Reaction system	Manufacture of other fabricated metal products (25.9)	Other fabricated metal products (25.9)	Multiplier available
Hydrodynamic system	Manufacture of other fabricated metal products (25.9)	Other fabricated metal products (25.9)	Multiplier available
Onshore infrastructure	Renting and leasing of other machinery, equipment and tangible goods n.e.c (77.39) Project management activities related to civil engineering works (71.12)	Renting of machinery (77.3) Architectural activities (71)	No multiplier for 77.39 No multiplier for 71.12

Sub-Activity[1]	Possible SIC Code[2]	Best Fit SIC Code with Multiplier[3]	Comments
			Use of two multipliers will mean expenditure has to be divided between them
Electrical equipment	Manufacture of electronic components (26.11)	Electronic components (26.1)	No multiplier for 26.11
Cabling	Manufacture of other electronic and electric wires and cables (27.32)	Insulated wire and cable (27.3)	No multiplier for 27.32
Foundations and moorings	Manufacture of articles of concrete, cement and plaster (23.6) Manufacture of structured metal products (25.1)	Articles of concrete (23.6) Structured metal products (25.1)	Multiplier available Multiplier available Use of two multipliers will mean expenditure has to be divided between them
Installation of marine energy device	Installation of industrial machinery and equipment (33.2)	Construction (41/42/43)	No multipliers for 33, used next closest
Installation of foundations and moorings	Specialised construction activities (43)	Construction (41/42/43)	No multiplier for 43
Installation of electrical systems	Installation of industrial machinery and equipment (33.2) Construction of communications and port transmission lines (42.22)	Construction (41/42/43)	No multiplier for 42.22 Use of two multipliers will mean expenditure has to be divided between them
Port services	Service activities incidental to water transport (52.22) Sea and coastal freight water transport (50.2)	Ancillary transport services (52)	No multiplier for 52.22
Land-related	Renting and leasing of other machinery, equipment and tangible goods n.e.c (77.39)	Renting of machinery (77.3)	No multiplier for 77.39
Insurance	Insurance (65.1)	Insurance and pension funds (65)	No multiplier for 65.1
Grid charges	Trade of electricity (35.14)	Electricity production and distribution (35.1)	No multiplier for 35.14
Maintenance	Repair of fabricated metal products, machinery and equipment (33.1)	Construction (41/42/43)	No multipliers for 33, used next closest
Operation	Project management activities related to civil engineering works (71.12)	Architectural activities etc (71)	No multiplier for 71.12

Notes:
1. Based on BVG Associates (2011): **Wave and Tidal Energy in the Pentland Firth and Orkney Waters: How the Projects Could be Built,** report commissioned by the Crown Estate, May 2011.
2. The input-output multipliers use the SIC (2003) codes. However, to enable the latest economic data to be used, it is necessary to map the multiplier data onto the SIC (2007) codes, based on Office for National Statistics (2009): **UK Standard Industrial Classification of Economic Activities 2007** (SIC 2007), Structure and Explanatory Notes, Cardiff. This will introduce some additional uncertainty into the assessment but means the most up-to-date information can be used as the baseline
3. Not every SIC code has a multiplier calculated for it, hence, it is necessary to consider the best fit multiplier

The greatest uncertainties with the multipliers are associated with installation activities and where there is a need to divide expenditure between two multipliers.

There is no information on GVA effect or employment effect multipliers for SIC code 33 (repair and installation of machinery and equipment). Instead, the multipliers for construction are used. This is likely to introduce a high degree of uncertainty since the activities listed under the SIC code for construction could be very dissimilar to the sub-activities described in BVG Associates (2011). BVG Associates (2011) shows installation and commissioning activities are predicted to account for around 15% to 20% of total undiscounted costs, therefore, this uncertainty could have a significant effect on the results. The potential for a high degree of uncertainty in the results of the top-down assessment highlights the importance of including a bottom-up approach.

BVG Associates (2011) does not provide a breakdown of expenditure between different activities, therefore, assumptions will need to be made on the proportion of expenditure that should be allocated to each multiplier. This will be based on project team experience and consultation with developers.

Multiplying Expenditure by the Appropriate GVA Effect and Employment Effect Multipliers

The supply chain benefits are estimated by multiplying the GVA effect or employment effect by expenditure (as shown in Figure C1). The available Input-Output multipliers are for Scotland as a whole (although some multipliers are available for the Western Isles). This means that the GVA and employment effects will be for the whole of Scotland, not the Pentland Firth and Orkney Waters area specifically. Information from the Annual Business Survey can be used to provide a high-level check on the likely reliability of the multipliers. Data from the Annual Business Survey provides information on approximate gross value added at basic process (and total employment) for four digit SIC codes (with codes available for the specific expenditure activities identified in BVG for the UK as a whole, as mapped onto SIC codes in Table C4 above). These data can be used to derive ratios for the four digit SIC codes which, if greater than the multipliers would suggest that the benefits derived from application of the multipliers are under-estimates. However, some case will need to be taken as the Annual Business Survey data on four-digit SIC codes is at UK-wide level, rather than being specific to Scotland.

To address this, and attempt to provide GVA and employment estimates that are more specific, the methodology requires a series of assumptions to be made. The approach proposed follows that in HIE (2010), where assumptions were made on the proportion of Scottish jobs that would be in the Highlands & Islands and in the PFOW area by category of job (e.g. manufacturing) the sub-categories of jobs within that (e.g. materials and manufacture, installation) and the activities within each sub-category (e.g. structure, electrical plant, control systems, cables). Breaking the jobs down in this way will require further assumptions to be made but it will also provide an opportunity to undertake validity checks of the number of jobs being estimated, for example, through consultation with HIE.

C.2.2 Reductions in Carbon Emissions

While it is possible to quantify the gross carbon savings associated with renewable energy generation, the estimation of potential net savings is extremely complex and dependent on a large number of factors including:

- Carbon emissions associated with manufacturing, construction and installation;
- Future energy demand;

- The baseline against which change is assessed (future energy supply mix, assumptions on displacement of energy supply and carbon intensity of displaced supply);
- The rate of grid decarbonisation;
- Future carbon prices; and
- The geographic scale of the assessment (Scotland vs UK).

Work is ongoing within Scottish Government to develop and agree an acceptable approach to estimating carbon emission savings in a Scottish context. In the interim, a simple approach is suggested whereby gross carbon savings from wave and tidal electricity generation are measured in relation to a standard baseline assuming 1:1 displacement of CCGT electricity generation.

The reduction in carbon emissions will assist in tackling global warming and will have a national and international impact. The benefits this may create socially are difficult to assess on a global scale. However, meeting energy objectives and creating a diversity of energy supplies should improve the Scottish and UK economies for future generations (Baxter *et al*, 2011).

C2.3 Improvements to Existing Infrastructure, Facilities and Services

The scale of PFOW development is likely to be accompanied by a range of improvements to existing infrastructure, facilities and services, for example, improvements to port facilities, improved transport connections, increased investment in tourism infrastructure (as a result of increased hotel occupancy) etc. While these improvements are primarily directed at facilitating PFOW (and future) wave and tidal developments, they will also provide benefits to a range of other users and interests.

It is generally not possible to quantify or monetise such benefits, but it is helpful to qualitatively identify such benefits where they occur.

C2.4 Benefits to Other Marine Users and Interests

The scoping exercise for potential socio-economic interactions (see section 2 of main report) identified the potential for PFOW projects to provide benefits to some other marine users and interests, for example:

- Spillover benefits for commercial fisheries from if areas act as *de facto* marine protected areas; and
- Ecotourism benefits (wave and tidal developments acting as visitor attractions).

While spillover benefits are theoretically possible, the evidence to support such claims is currently lacking. The scale of any benefits will be dependent on the size of the closed area and its functional importance for commercially exploited fish and shellfish. Given that the PFOW arrays will occupy small areas of sea space, any benefits would be anticipated to be very small. There may be potential to enhance spillover benefits, for example, by seeding closed areas with juvenile lobster. Trials of this approach are currently underway at one of the EMEC wave test sites (Jenny Norris, *pers comm*.). It is suggested that spillover benefits should only be considered if additional measures are being taken to enhance fish/shellfish stocks within an array.

There is some evidence from offshore wind farms that offshore renewable developments can form part of an overall ecotourism experience. The degree to which additional benefits may accrue will depend, to some extent, on additional promotion of wave and tidal developments, for example, the provision of a visitor centre. It is suggested that ecotourism benefits are only considered if there are accompanying actions to promote wave and tidal developments as a tourist attraction (e.g. visitor centre, visitor boards).

C2.5 Social Benefits

PFOW projects have the potential to increase local employment and to boost education and skills. Both of these may contribute to perceived improvements in the overall quality of life. Information on the number of jobs created/sustained should be available from project and cumulative assessments of supply chain benefits. While it may be difficult to quantify the contribution of PFOW projects to improvements in education and skills or perceptions of the quality of life, it may be possible to collect qualitative information at project level.

C2.6 Increases in Knowledge as a Result of Research and Development

The PFOW projects will lead to an increase in knowledge in the deployment of wave and tidal technologies and in understanding of the local marine environment (as a result of physical, chemical and biological surveys). While it is difficult to quantify or monetise the value of these benefits, it is helpful to qualitatively record such benefits.

C2.7 Supply Chain Development/Clustering

The PFOW projects will significantly stimulate and develop the UK supply chain to support wave and tidal energy developments. This will enhance the UK's capability in this area to service future domestic and international demand. While it is difficult to quantify or monetise the value of these benefits, it is helpful to qualitatively record such benefits.

C2.8 Improvements to energy security

The PFOW projects have the potential to contribute to national energy security, for example, where wave and tidal energy is displacing energy generated from imported gas. Given that it will be difficult to identify the particular generating capacity that is being displaced, it is difficult to determine the degree of benefit provided by PFOW projects. While it is difficult to quantify or monetise the value of these benefits, it is helpful to qualitatively record the potential for such benefits.

C3. Potential Adverse Impacts

C3.1 Introduction

Section 2 of the main report identified the potential for adverse impacts on the following marine users and interests, although the potential for impacts to occur very much depends on the nature and extent of the interaction and the ease with which impacts might be mitigated:

- Commercial fisheries;
- Commercial shipping;
- Ports & harbours;
- Tourism;
- Recreational boating;
- Water sports;
- Cables & pipelines; and
- Social impacts.

In assessing potential adverse impacts, it is appropriate to take account of basic mitigation measures that will be applied to projects. For example, any mitigation measures required to meet legislative requirements should be assumed to be in place (e.g. IALA lighting requirements will be in place to manage navigation risks).

A range of approaches have been used to assess adverse impacts between different socio-economic activities and interests in the marine area, depending on the focus of the studies. For example, in developing its Plan for Offshore Wind Energy in Scottish Territorial Waters (Marine Scotland, 2011), Marine Scotland used an impact assessment approach to seek to estimate the impact of the plan on marine users and other interests in terms of employment and GVA (ABPmer *et al*, 2011). However, in the context of EIA, there is no specific requirement to monetise socio-economic impacts, although in line with good EIA practice, it is helpful to seek to quantify such impacts where practicable. For significant and contentious impacts, it may sometimes be necessary to seek to monetise the impacts to inform negotiations with the affected parties, but it would not be expected that monetary information would be presented in an Environmental Statement.

The methodologies cover both potential direct impacts (e.g. physical displacement of one activity by another) but also indirect impacts (for example, impacts of a potential decline in water quality on an activity). However, when assessing the consequences of indirect impacts for socio-economic interests, it is important to take into account mitigation measures that are likely to be required as a result of environmental impact assessment or Habitats Regulations Appraisal processes which will generally seek to minimise such impacts to environmentally acceptable levels. Thus, requirements to minimise water quality impacts to protect environmental receptors should ensure that socio-economic impacts associated with changes in water quality are also minimised.

In carrying out socio-economic assessments, it is important that they are undertaken in an incremental and proportionate manner. In particular, consultation at EIA scoping stage can be useful in identifying which interactions may potentially be significant for a given development and thus might require further assessment within the EIA. In many cases, it should be possible to use information collected as part of other EIA studies to inform assessments of potential socio-economic impact. For example, predictions of impacts to fish and shellfish resources can help inform aspects of the assessment of socio-economic impacts to commercial fisheries. Similarly, the Navigation Risk Assessments for individual projects can help inform an assessment of socio-economic impacts to shipping, ports & harbours and recreational boating.

Where potentially significant interactions are identified it is generally possible to reduce or avoid negative impacts through careful site selection or scheme design, construction or operation. Where significant negative impacts cannot be avoided, it is often possible to agree mitigation/offsetting measures between the relevant interests through a formal legal agreement, although very occasionally, the impacts may preclude a development from proceeding.

The following sections below describe for each relevant activity/interest:

- The nature of the potential interactions and the potential negative socio-economic impacts;
- How the potential impacts might be assessed; and
- The suggested approaches to project and cumulative assessment.

The information has been compiled within summary tables as far as possible, together with a more detailed description of proposed project and cumulative methodologies.

C3.2 Commercial Fisheries

C3.2.1 Overview of interactions and potential impacts

The construction and operation of wave and tidal devices has the potential to negatively affect commercial fishing through:

- Reduction in or loss of access to traditional fishing grounds;
- Displacement of activity to existing (less profitable) fishing grounds;
- Consequent increase in fishing pressure and competition on alternative available grounds;
- Obstruction of navigation routes to and from fishing grounds leading to increased steaming times;
- Fouling of fishing gear on cables and seabed infrastructure;
- Disturbance of mobile species and disruption or damage to habitats, nursery and spawning grounds; direct damage to sessile species, leading to displacement of or reduction in fish (including salmon and sea trout)and shellfish resources (although this impact depends on the type of technology to be employed at the site);
- Potential reduced Catch Per Unit Effort (which is exacerbated by cumulative effects of other pressures on fishing areas, including other wave and tidal devices, offshore wind farms, Marine Protected Areas, oil and gas, aggregate extraction, dredging and port developments) and consequential loss of profit; and
- Knock-on consequences for fish producers dependent on local supply, if fish landings are reduced.

The negative impacts (if realised) could lead to potential reductions in catch value and increases in costs to the fishing industry with consequent economic impacts on the commercial fishing sector.

Table C5 summarises the potential impacts and socio-economic consequences and how they might be assessed. More information on the assessment approaches is provided below.

Table C5. Summary of Potential Impacts to Commercial Fisheries and Assessment Approaches

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Loss of or displacement from traditional fishing grounds; displacement to existing fishing grounds; and consequent increase in fishing pressure	Reduction in landings values	Quantify potential displacement effect in terms of fish landings	✓ Apply Cefas methodology	✓ Estimate based on assumptions
Disturbance of mobile species and disruption or damage to habitats, nursery and spawning grounds	Reduction in landings/Catch per Unit Effort (CPUE)	Assessment of species and habitats within EIA/HRA procedures	✓ As part of EIA/HRA	×
Obstruction of navigation routes	Increased steaming times	Assessment of number of vessels affected and scale of deviation	✓ Face to face meetings with fishing associations and/or fishermen	×
Fouling of fishing gear on cables or seabed infrastructure	Loss of fishing gear	Assessment of potential frequency of fouling events	✓ Face to face meetings with fishing associations and/or fishermen	×
Cumulative effects of other pressures	Reduction in CPUE and consequential loss of profit	Assessment of cumulative issues within EIA/HRA procedures	× Part of cumulative effects study	✓ Overall evaluation as part of cumulative effects study
Reduction in supply of fish to processors	Loss of profit	Assessment of significance of any reduction in landings to fish producers	×	✓ Overall evaluation as part of cumulative effects study

C3.2.2 Suggested approaches to assessing interactions

Fisheries Displacement

Individual project assessments will be required to identify specific local impacts on individual fishermen as a basis for identifying any necessary mitigation. Consultation should be undertaken with relevant fishermen's representatives, to capture local fishermen's views.

At project scale, there is a standard methodology for assessing fisheries impacts which has been extensively applied for marine aggregate dredging ('A procedure to assess the effects of dredging on commercial fisheries' Report No. A0253, Cefas (2002)). This assessment is based on the fish resources and commercial fisheries which are likely to be sensitive to the potential impacts, for example:

- Fish resources (spawning and nursery grounds);
- The benthic fish community; and
- Commercial fishery.

It is assumed that detailed descriptions of all these aspects will be available from project level EIAs to provide information for the assessment process.

At a project level, consideration should also be given to potential impacts on local salmon and sea trout fisheries. These fisheries tend to lie in estuaries, lochs or rivers, which are unlikely to be in similar locations to wave and tidal devices, but consultation with salmon and sea trout fisheries interests should be undertaken to identify and address any concerns.

Cumulative assessment should consider the potential cumulative effects of multiple wave and tidal developments including in-combination with other impacts on fisheries (for example, possible displacement from offshore wind farm areas and marine protected areas).

At a regional scale, a range of fisheries data is available including existing landings value data, effort data, surveillance sightings data and VMS position data (>15m vessels only). Using assumptions on the catch locations of fish within ICES rectangles and assumptions on the extent and consequences of displacement, it is possible to obtain indicative information on economic impacts. Such an approach was adopted in considering regional scale impacts of the draft plan for offshore wind in Scottish territorial waters (ABPmer *et al*, 2011). However, the landings data is only available at the level of ICES rectangles which provide only a very coarse indication of where fish have been captured. While VMS data is more spatially resolved, this is limited to vessels >15m and will therefore significantly underestimate inshore fisheries activity in PFOW where the majority of vessels are <15m. Wave and tidal development areas cover a very small proportion of any individual ICES block and the assumptions that would need to be made about impacts render this approach impractical even for a regional scale assessment.

Marine Scotland is currently collating detailed baseline information on inshore fisheries around Scotland (The 'Scotmap' project). This information should support a more detailed cumulative effects assessment of the potential impacts of potential displacement. The cumulative assessment should take account of emerging proposals for MPAs (there is an MPA 'Area of Search' to the North and East of Orkney). It should also take account of any implications of changes in the Common Fisheries Policy (CFP) or national fisheries policies – the latter are likely to be more relevant, given the inshore location of the PFOW sites.

Disturbance to Mobile Species, Damage to Habitats

Data and assessments within project level EIAs and HRAs can be used to inform assessments of the likelihood of significant disturbance to mobile species or damage to feeding, spawning or nursery habitats. Given the statutory requirements to minimise or avoid such impacts, the consequences for commercial fisheries are likely to be very minor. Where significant residual impacts remain, these should be considered under the project level fisheries assessment procedure (see above).

Obstruction to Navigation

Obstruction of existing navigation routes may be an issue at project level, depending on the nature and extent of any restrictions imposed and the significance of any changes in steaming distance/time. Information on these issues should be available from project level navigation impact assessments or wider project level consultation with fisheries interests which could be used to inform an assessment of impacts. It would be possible to estimate additional time and fuel costs using the methodology suggested for shipping (Section C3), adapted as required.

Fouling of Fishing Gear on Cables/Seabed Infrastructure

The risk of fouling may be an issue at project level, particularly where export cables traverse existing fishing grounds. Potential issues are best identified through project level consultation. It may be possible to avoid such risks through careful siting of the export cable or adequate cable burial. Where fishing effort may be displaced as a result of a cable, the impact to affected fishermen could be estimated using the methods described for displacement.

Reduction in Supply of fish to Fish Processors

If the PFOW projects result in a significant reduction in fish landings, this could have consequences for the profitability of fish processors, particularly where these are dependent on locally caught fish and shellfish. Should the cumulative effects assessment indicate a significant potential for reduction in landings, the impacts on fish processors should be considered, taking account of the scale of any reduction in landings and the dependence of individual processors on those landings.

C3.3 Commercial Shipping

C3.3.1 Overview of interactions and potential impacts

Wave and tidal developments within the study area have the potential to affect commercial shipping interests in a number of different ways. Potential negative effects include:

- Obstruction of transiting vessel navigation routes resulting in:
  - Increased steaming distance/time;
  - Increased ship emissions due to extended passage distance; and
  - Potential for increased marine risk (grounding) through constriction of navigable areas;
- Obstruction of established ferry routes resulting in;
  - Increased steaming distance/time; and
  - Reduced turn around time at port;
- Increased ship collision risk due to decreased navigable areas;
- Displacement of recreational craft into commercial shipping lanes;
- Aids to navigation (typically buoyage) required to mark development areas used by vessels as waypoints;
- Displacement of anchorage areas; and
- Fouling of anchors on seabed cables.

Many of the potential negative effects can be mitigated by developers through careful siting of developments, appropriate marking and lighting of developments and adequate cable burial. However, should impacts occur this could lead to increased costs for the shipping sector. Table C6 summarises the potential impacts and socio-economic consequences and how they might be assessed.

Table C6. Summary of Potential Impacts to Shipping Sector and Assessment Approaches

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Obstruction of transiting vessel navigation routes: Increased steaming distances/time	Increased costs; increased insurance costs	Assess potential additional steaming distances/times	✓ As part of navigation impact assessment	✓ As part of navigation impact assessment
Obstruction of established ferry routes: Increased steaming distances/time Reduced turnaround times	Increased costs to ferry companies	Assess potential additional steaming/time costs	✓ As part of navigation impact assessment	✓ As part of navigation impact assessment
Increased ship collision risk, increased risk of grounding	Increased costs; increased insurance costs	Developer must demonstrate risks are acceptable - additional costs to shipping sector unlikely	✗	✗
Requirement for additional aids to navigation	Costs of meeting IALA requirements met by developers	Not required for economic assessment	✗	✗
Displacement of anchorage areas	Increased costs	Assess potential additional steaming/time costs for alternative anchorages	✓ As part of navigation impact assessment	✗
Fouling of anchors on cables	Increased insurance costs	Developer must demonstrate risks are acceptable - additional costs to shipping sector unlikely	✗	✗

C3.3.2 Possible approaches to assessing the interactions

Obstruction of Transiting Vessel Navigation Routes

Increased steaming distance/time (transiting and established ferry routes)
Access to AIS data is required to undertake the assessment. The data is not readily available from national sources, such as the Maritime & Coastguard Agency (MCA). The MCA make available area

density maps derived from AIS data (see Baxter, *et al*, 2011 as an example). However, this information does not provide resolution of vessel type, vessel draught or vessel specifics needed to conclude the effects on route deviation. AIS data may be obtained from other sources include contacting local VTS centres (such as Orkney VTS) or third party suppliers (e.g. Lloyd's List Intelligence) although a charge for the data is likely to be made. Marine Scotland has initiated a study to collect more detailed information on shipping movements within the PFOW area. This study is expected to report in autumn 2012 and should provide much of the information required for individual project and cumulative assessments.

Increased steaming time and distance can be assessed by taking a number of typical vessel routes, based on AIS data interrogation and calculating the deviation required to safely pass the development site. Such information should be available from the Navigation Risk Assessment (NRA) and impact assessment. Safe passing distance for each site would need establishing on a site specific basis, considering factors such as the proximity of shallow water, tidal flow considerations and prevailing (annualised) weather. The 'diverted' route needs to be a viable option to make the assessment credible. This assessment should be carried out on main transit routes, and established ferry routes. It should take account of potential cumulative effects where more than 1 PFOW development affects the same route.

Table C7 provides generic cost information which could be used to assess the cost of route alterations if required, although generally, the navigation impact assessment should be sufficient to inform an assessment of socio-economic impacts within the EIA. Prior to carrying out an assessment on established ferry routes, the route operator must be contacted to ensure that all routes used by the service are considered. Routes may vary significantly in complicated tidal areas where vessels make use of specific tidal flow characteristics to minimise risk and optimise fuel costs.

Table C7. Generic Data Used in Calculating Costs for Additional Steaming Time

Vessel Description	Fuel Consumption (tonnes per hr.)	Fuel Cost (£s/tonne)	Manning Costs (£s per hr.)	Assumed Cruising Speed (knots)
Bulk cargo vessel	0.4	650	750	15
Coaster	0.13	650	200	8.5

(Source: ABPmer *et al*, 2011)

Commercial losses due to decreased turn around time (for ferry services as a consequence of increased steaming time)

This receptor will be route specific, and dependant on a number of local operating circumstances. For regular trade on scheduled services, the difference in transit time would need to be reduced to a level where additional manpower is needed to service the vessel in port prior to departure. Active liaison with route operators would be needed to establish the time required to service a vessel prior to vessel departure (fuel, water, stores, cleaning etc) and whether the increase in transit time (and reduction of port dwell time) would negatively affect the service. The requirement for increased manpower (and, hence, increase in costs) could mean that there is a negative impact in terms of commercial profitability, but could be positive for local employment.

Increased Ship Collision Risk/Grounding Due to Decreased Navigable Areas and Displacement of Recreational Craft into Commercial Shipping Lanes

To estimate the impact of this interaction a qualitative marine risk assessment should be completed to inform the process. This should normally be available as a required study to inform the EIA. If the development area and the adjacent sea area is complex (many vessel route interaction, a significant number of vessel movements, and/or complex tidal conditions) then a quantitative vessel study using input traffic levels (from AIS and/or radar surveys) would provide a robust marine risk assessment. This should be carried out at a project site specific level.

For a development to proceed, it will be necessary to satisfy the relevant authorities that navigation risks are acceptable. On this basis, there should be no significant additional costs to the shipping sector and no economic impact assessment should be required.

Aids to Navigation (Typically Buoyage) Required to Mark Development Areas Used by Vessels as Waypoints

The visibility of offshore wave and tidal energy installations will depend on the device type. Some installations are totally submerged, whilst others may only protrude slightly above the sea surface. The marking of offshore wave and tidal energy installations are recommended to follow advice from the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). These recommendations vary depending on the type of wave/tide generating equipment, connecting cabling from the site and whether there are any installations likely to be a danger to surface navigation.

Each site should be considered against this guidance with due consultation with the Local Lighthouse Authorities and General (National) Lighthouse Authorities. As a guide, it would be expected that the 'corners' or other significant points within the development site are adequately marked with buoyage, lights and other aids to navigation such as RACON and AIS equipment transmitting equipment (IALA, 2008). The costs of implementing IALA requirements will fall to developers and therefore there should be no additional costs to the shipping sector.

Displacement of Anchorage Areas

Development sites should be considered for displacement of anchorages used by shipping. This can be established from AIS or radar surveys of the area in comparison with sea usage charting. This information should be matched to local Harbour Authorities information on both formal and informal anchorage within their Harbour Authority areas. The purpose of the anchorage should be considered, and whether other alternative sites are available locally. The potential cumulative effects of displacement should also be considered. Any effect on increased steaming distances/times could be quantified using similar methods to those described above.

Fouling of Anchors on Seabed Cables

Routing of cables from the development site to the shore needs assessing in terms of any potential interaction with formal or informal anchorage areas. This should be addressed through the Navigation Risk Assessment. Consideration of buoyage/marked posts may be required to advise marine users of inshore areas at points where cables make landfall. An economic assessment should not be required.

C3.4 Ports & Harbours

C3.4.1 Overview of interactions and potential impacts

Impacts to shipping have the potential to affect trade passing through ports, particularly in circumstances where impacts mean that shipping routes become less viable and shipping lines seek to identify alternative routes to another port or harbour. Potential negative impacts include:

- Access routes to port and harbours are altered:
  - Deviation of routes;
  - Constriction of channel widths due to development site boundary; and
  - Shipping operators use alternative routes due to increased risks navigational risk of development sites;
- Sub-sea tidal generating equipment placing restrictions on ship draught;
- Restriction on ability of ports & harbours to develop and expand operation (by dredging/construction) through wave and tidal development sites restricting access; and
- Loss of or disruption to existing dredge material disposal sites.

Many of the potential negative effects can be mitigated by developers through careful siting of development and active liaison with ports & harbours likely to be affected by the proposed sites. However, should impacts occur this could lead to increased costs or loss of revenue for ports & harbours. Table C8 summarises the potential impacts and socio-economic consequences and how they might be assessed.

Table C8. Summary of Potential Impacts for Ports & Harbours and Assessment Approaches

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Obstruction of existing navigation routes	Loss of customers and revenue; increased costs associated with maintaining alternative routes	Assess location and significance of vessel displacement	✓ As part of navigation impact assessment	✗
Reduced development opportunities	Loss of customers and revenue (long-term); increased costs associated with development	Assess location and significance of interaction	✓ Through discussions with port & harbour authorities as part of EIA	✗
Loss or reduced use of dredge material disposal sites	Increased costs of disposal	Assess location and significance of interaction	✓ Through discussions with port & harbour authorities as part of EIA	✗

C3.4.2 Suggested approaches to assessing interactions

Access Routes to Ports are Altered

To assess this interaction, routes passing over or around development sites should be assessed against ports & harbours to which vessels commence or terminate their passage. This can be highlighted by examining AIS data track plots and through direct contact with port and harbour authorities to establish routing practice. Any deviation in route should be quantitatively assessed to conclude the extension in passage time (see Shipping Section). Where development sites allow the passage of vessels, a draught analysis should be conducted to ensure the deepest draughted vessels using the port or harbour may continue to trade at their current tidal access window. Effects of development sites on vessel routes to ports & harbours should be considered at Lowest Astronomical Tide (LAT) to present the worst case scenario. Economic effects of reducing tidal access windows (and increased berth dwell times) can be assessed by calculating port berthing costs as a function of time.

Any reduction in navigable areas, leading to a restriction of two-way passing of vessels should be assessed. This may affect vessel passage plans and departure times for vessels. This should be assessed on a site specific basis. If risks are considered to be too high, shipping lines may make strategic decisions to use alternative routes, potentially taking trade to other ports & harbours. This interaction can only be assessed qualitatively through expert judgement, and is likely to be secondary to environmental concerns such as weather and sea state.

If development sites allow the navigation of vessels over installed devices, a comprehensive assessment of ship draught should be completed. This will use AIS data to understand current usage, and port access guides to ascertain the limits of ship acceptance for ports & harbours in the vicinity of the site. This will allow planning for tidal device clearance specific to the site under consideration, typically in areas used by shipping, 15 to 20m clearance would be needed from the highest point of the structure (blade) to the sea surface at LAT. An understanding of the type of trade prevalent on affected routes would be needed to inform the assessment, this can be taken from AIS data or through consultation with port and harbour authorities.

Ability of a port to develop and expand its operation (by dredging/construction) through wave and tidal development sites restricting access.

A consequential effect of development sites in areas used by shipping to access ports could be a restriction in potential vessel draught increases, or the opening of new shipping services. Ports are reactive and dynamic facilities, responding to changing markets and trade demands. A site specific assessment should be conducted in consultation with ports affected by development sites to understand future port development aspirations.

Loss or Disruption to Dredge Material Disposal Sites

Dredge material disposal sites are generally located to minimize the costs associated with disposal while taking account of the need to ensure adequate environmental protection. The use of less preferred disposal sites could lead to increased disposal costs. A site specific assessment should be conducted in consultation with relevant port & harbour authorities for any affected disposal sites. Additional costs could be calculated based on similar methods applied to shipping above.

C3.5 Tourism

C3.5.1 Overview of interactions and potential impacts

Tourism is often associated with other specific recreational activities including marine ecotourism, recreational boating and a range of other water sports. This section focuses on general tourism, ecotourism and tourism associated with maritime and coastal heritage. Interactions with recreational activities are described in a later section of this appendix.

Wave and tidal development may negatively affect tourism interests through:

- Visual effects on the landscape and seascape[9] deterring visitors to an area or deterring tourism investment;
- Changes to the local character of an area as a result of development or during construction, maintenance or decommissioning activities;
- Disturbance or injury to coastal or marine wildlife interests (e.g. for wildlife watching) during construction wave and tidal renewable energy developments;
- Disturbance or damage to heritage assets; and
- Disruption to site access for tourism operations.

The negative impacts (if realised) could lead to potential reductions in levels of tourism activity with consequent economic impacts on the tourism sector.

Table C9 summarises the potential impacts and socio-economic consequences and how they might be assessed.

Table C9. Summary of Potential Tourism Impacts and Assessment Approaches

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Impacts to landscape or seascape	Reduction in tourism income	Assess significance of changes through LVIA; consultation with stakeholders	✓ As part of LVIA/ EIA	×
Changes to the local character of an area	Reduction in tourism income	Assess significance of changes through LVIA; consultation with stakeholders	✓ As part of LVIA/ EIA	×
Disturbance or injury to coastal or marine wildlife	Reduction in income for ecotourism businesses	Assessment of impacts to sensitive receptors e.g. marine mammals; consultation with stakeholders	✓ As part of EIA	×

9 For the purposes of this study, the definition of 'seascape' has been taken from DTI (2005) in which it is stated that seascape is a term for: "*the coastal landscape and adjoining areas of open water, including views from land to sea, from sea to land and along the coastline" and describes "the effect of landscape at the confluence of sea and land.*"

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Disturbance or damage to heritage assets	Reduction in visitor attraction income; reduction in wider tourism income	Assessment of consequences for visitor attraction income; consultation with stakeholders	✓ As part of EIA	✗
Disruption to site access	Reduction in attraction income	Assessment within traffic impact assessment; consultation with affected parties	✓ As part of EIA	✗

C3.5.2 Suggested approaches to assessing interactions

There is limited research on the visual impact of wave and tidal development and the potential consequences for tourism. The Marine Renewables SEA (Scottish Executive, 2007) identified key potential effects from wave and tidal devices on seascape types, as follows:

- For linear structures, with devices at 0-5km from the coastline, moderate to major effects may occur for all seascape types. The further from the coast, the less the effect becomes, and beyond 10km the effects are typically minor;
- For point structures, 8 out of the 10 seascape types are of high sensitivity to these types of device, with potential major or moderate effects occurring at 0-10km from coastline. Moderate effects may also occur at distances over 10km;
- Submerged structures are likely to have negligible effects on seascape (although marker buoys and lighting may be required); and
- Fixed coastal structures may have moderate effects depending on their design and location.

The Marine Renewables SEA was, however, undertaken at a very broad level, using generic device characteristics and seascape types rather than site-specific device characteristics and accurate characterisation of coastal and seascapes that is required as part of a Landscape and Visual Impact Assessment (LVIA's).

Research on the tourism impacts of onshore wind farms in Scotland by Glasgow Caledonian University (GCU) and Cogent Strategies International Ltd suggests that the impact from on-shore wind farms on visitors' intentions to return to the area is likely to be low (Riddington *et al*. 2008). The report found that the vast majority of visitors (93-99%) who had seen a wind farm suggested that the experience would not have any effect; in fact there were some tourists for whom the experience increased the likelihood of a return visit rather than decreasing it. The research estimated that the predicted reduction in general tourist expenditure for the Caithness and Sutherland region would be 1.54% (Riddington *et al*. 2008). However, the height of many wave and tidal devices above sea level (often less than 10m), makes them more analogous to fish farms which tourists perceive as being of less impact visually than wind farms (Royal Haskoning, 2010; Riddington *et al*. 2008). Therefore, the effects of impacts to landscape and seascape on tourism would generally be expected to be much smaller than for wind farms. However, perception is important, particularly given the unspoilt nature of much of the coastline and concerns about impacts on tourism could deter future investment.

Commercial ecotourism tours such as whale watching boat trips have the potential to be impacted directly by the physical presence of renewable devices by making access difficult to routes often used by the boats or by interrupting lines of sight while scanning for wildlife with scopes or binoculars. However, around the PFOW area, most marine and coastal wildlife watching is focused on viewing species on or near to the shore (such as seals, otters and nesting seabirds) with only a limited amount of wildlife watching undertaken offshore. Therefore, access disruption and the interruption of lines of sight are expected to be minimal. In addition, changes to the abundance or distribution of target species in an area arising from potential environmental impacts such as collision or noise could cause 'knock-on' effects to the marine wildlife tourism sector. Although there is some uncertainty concerning actual environmental impacts, most of the species of interest to marine ecotourism such as cetaceans, seals and seabirds are protected under the EC Birds and Habitats Directives with a legal obligation to ensure that adverse effects on the integrity of designated sites are avoided. There are also wider provisions for the avoidance or minimisation of disturbance of protected species. Therefore, any impact to marine ecotourism species would be expected to be very minor and knock-on effects to the marine ecotourism economy negligible.

Heritage assets (both terrestrial and marine) may potentially be affected by wave and tidal development in the area. Direct impacts may occur as a result of construction activities and indirect impacts may occur as a result of operational activity or visual impact. The potential for direct impacts will be site/project specific and should therefore be considered as part of heritage impact assessment within project level EIAs. The visual impacts on heritage assets can be taken into account within project level LVIAs.

Based on evidence from the aquaculture industry, impacts on tourism associated with wave and tidal development would be expected to be very minor, but given the importance of unspoilt coastline and sea views to the tourism industry, it is important that adequate consideration is given to potential impacts of individual projects.

There is currently no robust methodology for assessing potential negative impacts on tourism associated with wave and tidal energy developments. The main potential for negative impacts relates to changes in the landscape and seascape. It is suggested that if any development gives rise to significant negative landscape and visual impacts, then further consideration should be given to potential negative tourism impacts. For example, it would be possible to estimate the numbers and relative importance of tourism facilities where views are significantly affected (accommodation, tourist attractions etc).

C3.6 Recreational Boating

C3.6.1 Overview of interactions and potential impacts

Wave and tidal power developments within the study area have the potential to affect recreational boating in the following ways:

- Alterations to informal cruising routes;
- The perceived risk from development site equipment which is at, or near the surface could deter recreational boat owners from using areas or routes, providing displacement of traffic to other routes (with onward effects to the operators of port, harbour and marina facilities);

- Displacement of recreational boat activities into deeper water and/or areas of adverse tidal conditions increasing the navigational risk; and
- Deterrent to future investment in marina capacity and the wider recreational boating supply chain.

Many of the interactions identified in this section are very similar in type to those identified for the Shipping section, and potential negative effects can be mitigated through careful site selection. However, should impacts occur this could lead to some increased costs for recreational boat users, which may result in some loss of revenues for the supply chain if boat owners relocate vessels elsewhere. Table C10 summarises the potential impacts and socio-economic consequences and how they might be assessed.

Table C10. Summary of Potential Recreational Boating Impacts and Assessment Approaches

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could Be Assessed	Individual Project Assessment	Cumulative Assessment
Alterations to informal cruising routes	Increased fuel costs for motorized vessels; possible relocation of vessels leading to loss of revenues for supply chain	Assess potential additional fuel costs; consultation with stakeholders	✓ As part of navigation impact assessment	✓ As part of navigation impact assessment
Displacement of vessels into higher risk areas	Increased costs to boat owners; possible relocation of vessels leading to loss of revenues for supply chain	Developer must demonstrate risks are acceptable; consultation with stakeholders	✗	✗
Deterrent to investment in marinas/supply chain	Reduced investment	Consultation with recreational boating sector	✓	✗

C3.6.2 Suggested approaches to assessing these interactions

Alterations to Informal Cruising Routes

At a project scale interactions can be addressed through the use of site specific evaluations and navigation risk assessments and more detailed local consultation. Impacts to recreational boating routes should be assessed using statistics from the Royal Yachting Association (RYA) and information from marina and port authorities with pleasure boat count data. Some additional information may become available towards the end of 2012 when the Marine Scotland navigation study is completed.

Displacement into Higher Risk Areas

The navigation impact assessment should identify the extent to which recreational vessels might be displaced into higher risk areas. To the extent to which this was assessed as being significant, mitigation measures would be anticipated to be put in place to ensure that residual risks were acceptable. On this basis, no socio-economic impacts should occur.

Should significant concerns remain, it may be appropriate to seek to evaluate the effects of possible reduced usage of cruising routes and any resulting reduction in spend at port services (fuel, water, food purchase, berthing fees etc).

Deterrent to Investment

The risk of deterring investment in marina capacity or the wider supply chain cannot be quantified. Consultation with the supply chain, particularly local marinas, should be undertaken to identify and address potential concerns relating to individual projects.

C3.7 Water Sports

C3.7.1 Overview of interactions and potential impacts

The main water sports undertaken in the PFOW area that are likely to have interactions with wave and tidal devices are recreational angling, dingy sailing, surfing, windsurfing, kayaking and scuba diving. The main potential impacts of concern for water sports associated with PFOW projects include:

- The visual impact of wave and tidal development on the seascape setting for water sports;
- Displacement or obstruction of water sports from an area;
- Wave or tidal structures creating a collision risk for participants or watercraft;
- Changes to coastal processes such as a reduction in the quality of the wave climate for surfing (wave height, period and direction) altering the quality and consistency of a surfing location. As a wave passes through a renewable development, there is potential for energy to be blocked, re-directed and particularly in the case of wave energy converter devices, extracted by the device structures, impacting on wave height and wave angle. In addition, it is also feasible that devices could change the sedimentary conditions on a beach such as sand bar position (which could influence the quality of a wave) through changes in sediment transport to beaches (SAS, 2009); and
- Impacts on fish stocks of angling target species during construction and/or operation of wave and tidal facilities as a result of impacts to feeding, breeding and/or migration of species of angling interest (e.g. collision risk or disruption/disturbance through increased noise, vibration, turbidity or electromagnetic fields).

All the potential negative impacts could affect the local economy through the displacement of water sports activities to other areas which could lead to increased costs or loss of revenue for the relevant supply chains. Table C11 summarises the potential impacts and socio-economic consequences and how they might be assessed. Further information on the methodologies is provided below.

Table C11. Summary of Potential Impacts to Water Sports and Assessment Approaches

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could Be Assessed	Individual Project Assessment	Cumulative Assessment
Impacts to seascape/setting	Reduction in activity levels leading to loss of revenue for supply chains	Assessment of visual impact within EIA/HRA process; assessment of potential displacement in consultation with stakeholders	✓ Sites assessed within project EIA/HRA	✗
Displacement or obstruction of water sports activity	Reduction in activity levels leading to loss of revenue for supply chains	Assessment of potential displacement in consultation with stakeholders	✓ Specific user surveys	✗
Collision risk for humans or vessels	Reduction in activity levels leading to loss of revenue for supply chains	Assessment of potential displacement in consultation with stakeholders	✓ From navigation impact assessment	✗
Impacts to wave quality (surfing)	Reduction in surfing activity leading to loss of revenue for supply chain	Assessment of potential displacement in consultation with stakeholders	✓ Specific user surveys	✗
Impacts to fish resources (angling)	Reduction in recreational angling leading to loss of revenue for supply chain	Assessment of fish species within EIA/HRA process	✓ Sites assessed within project EIA/HRA	✗

C3.7.2 Suggested approaches to assessing the interactions

Water sports undertaken in the PFOW are generally only undertaken in very discrete locations, such as a surfing beach, dive site or angling spot (with the exception of sea kayaking and to a lesser extent windsurfing). The significance of the interactions between different water sports and wave and tidal devices in the PFOW area is generally expected to be low. However, the magnitude of such impacts will still vary considerably between each of the different development sites due to site-specific factors (such as device characteristics) and with the degree of overlap with important functional areas for water sports. In addition, predicted interactions would be expected to occur in relatively localised areas (near or in the development sites) and the economic consequences of such impacts for local business such as shops or hotels would also expected to be relatively localised.

To understand the potential scale of possible impacts, it is helpful to collect reliable baseline information on existing levels of activity and expenditure and to understand the particular values that recreational users associate with specific locations. Further guidance on suitable techniques for collecting this type of data are contained in the 'MEDIN Data Guideline for the Leisure and Recreation Sector' (Pearson *et al*, 2011).

The assessment of potential changes in water sports activity as a result of wave and tidal development will need to take account of the predicted changes in the physical resources on which such activities depend (e.g. wave climate, seascape etc) but will require an element of judgment to be applied as the user experience is to some extent subjective. Such assessments are therefore best undertaken in consultation with the interested stakeholders and in the light of knowledge of the particular values stakeholders apply to specific locations. They will need to draw on project level information and would therefore best be undertaken in the context of project level EIAs.

C3.8 Cables & Pipelines

C3.8.1 Overview of interactions and potential impacts

Wave and tidal developments have the potential to interact with telecom and power cables and oil & gas pipelines through:

- Competition for space; and
- Increased difficulty of access for cable & pipeline maintenance and inspection where cables and pipelines are in close proximity to other infrastructure and/or if crossings with wave and tidal cables occur.

The economic consequences of the potential negative interactions can be substantial. Proximity to other infrastructure or cable/pipeline crossings may significantly increase costs and time taken to repair or maintain existing cables and pipelines. Where such cables or pipelines provide the only delivery route for a good or service, delays in repairing them may also have significant knock-on economic consequences, both in terms of asset owner revenues, but also for those businesses dependent on such services.

It is therefore very important that interactions are minimised through careful site selection and cable route planning. For example, current UKCPC guidance is that a buffer of 1km should be provided either side of cable routes to provide sufficient space for access. Table C12 summarises the potential impacts and socio-economic consequences and how they might be assessed.

Table C12. Summary of Potential Cable & Pipeline Impacts and Assessment Approaches

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Competition for Space	Increased costs associated with new cable or pipeline laying operations; increases in subsequent maintenance costs	Consultation with stakeholders	✓ As part of consultation on EIA	✗
Increased difficulty of access	Increased maintenance costs for cable & pipeline owners; loss of revenue for asset owners; loss of revenue for dependent businesses/customers	Consultation with stakeholders	✓ As part of consultation on EIA	✗

C3.8.2 Possible approaches to assessing the interactions

There are no pipelines in the PFOW development area that might interact with PFOW projects. The Northern Lights telecom cable intersects 3 development areas including the West Orkney Middle South, West Orkney South and Brough Head sites. A power cable intersects the Westray South site.

The consequences of interactions with existing telecom and power cables are situation specific and can only be sensibly addressed at project level. It is therefore important that the relevant developers engage in early consultation with the asset owners, as the cost impacts are potentially significant.

An assessment of cost impacts would need to take account of potential increases in maintenance and inspection costs based on requirements for and the nature of any cable crossings and changes in accessibility. It would also need to take account of the possible consequences of the increased time taken to repair damaged cables in terms of impacts to asset owner revenues and the consequential economic impacts to dependent businesses and customers.

C3.9 Social Impacts

C3.9.1 Overview of interactions and potential impacts

In addition to the potential social benefits identified in section C2, PFOW projects have the potential to give rise to adverse social impacts. There is no agreed definition of the social considerations that should be considered within an EIA. The following aspects have been identified as some of the more potentially significant social factors for which changes as a result of PFOW projects might be measurable:

- Employment (reductions in employment in existing marine activities);
- Capacity of existing public infrastructure (transport, schools, health services);
- Housing availability and prices;
- Changes to existing landscapes and seascapes.
- Changes to the "Quality of Life"; and

The potential social impacts identified above are linked to and dependent upon the level of environmental and economic impacts (described within previous sections). The negative impacts (if realised) could lead to potential reductions in the welfare of some people living in the region. Identification of potential impacts early in the development process should enable resources to be targeted towards avoiding or minimising significant impacts and provide opportunities for delivering community benefit.

Table C13 summarises the potential impacts and socio-economic consequences and how they might be assessed.

Table C13. Summary of Potential Social Impacts and Assessment Approaches

Impacts	Potential Socio-economic Consequence	How Socio-economic Impact Could be Assessed	Individual Project Assessment	Cumulative Assessment
Local employment	Reduction in employment opportunities	Based on negative impacts to other sectors	✓	(✓)
Infrastructure	Pressure on existing infrastructure	Potential demand in relation to capacity (transport infrastructure, health services, schools)	✗	✓
Housing availability	Pressure on housing availability leading to increased housing prices	Potential housing demand in relation to capacity	✗	✓
Quality of Life	Reduction in welfare	Quality of Life Indicators	✓	✗
Landscape/seascape	Reduction in visitor attraction income; reduction in wider tourism income	Assessment of landscape/seascape within EIA process	✓ As part of LVIA	✗

C3.9.2 Suggested approaches to assessing interactions

The PFOW projects have the potential to displace existing marine users, which could affect employment in these sectors. The potential for any impacts can be evaluated from the assessments of interactions with individual sectors. This should be considered at project level. It may also be possible to estimate the scale of the possible cumulative effect for some sectors, where cumulative effect studies are available.

Potential impacts on some aspects of public infrastructure can be estimated based on projected changes in employment and information on the likely future demands on public infrastructure relative to existing capacity, for example, schools and hospitals. Similarly, prospective demands for housing can be compared with housing availability and the risks to house price inflation. Both of these assessments are best done using estimates of cumulative effects on employment.

Impacts on the 'Quality of Life' could be considered in relation to national indicators but such assessments are likely to be subjective. Consultation with local communities will be important to elicit public opinion and to determine how best to minimise the negative impacts which they anticipate will impinge on their local communities. This is best taken forward at project level.

The significance of changes to landscapes and seascapes can be assessed through project level LVIAs. Consultation with local communities to determine key views and their sensitivities should ensure that the LVIAs take account of the perspectives of local residents.

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