

Pentland Firth and Orkney Waters Marine Spatial Plan Framework

&

Regional Locational Guidance for Marine Energy

Final Report

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The Report is presented in two parts.

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FOREWORD

The Marine (Scotland) Act 2010 is bringing into force a new statutory marine planning system to manage the increasing, and often conflicting, demands on Scottish seas. For the first time, a National Marine Plan will give greater clarity to decision making in the marine environment, reduce uncertainty for marine developers and encourage economic investment.

We are developing a marine spatial plan for the Pentland Firth and Orkney Waters area. This area has been chosen because of its high level of wave and tidal resources, which has recently led to the world's first commercial lease agreements for the development of wave and tidal power to be issued. Developing this marine plan will help inform development of the National Marine Plan.

Marine renewables are an essential component of ensuring that the Scottish Government achieves its stated target of meeting 80% of Scottish demand for electricity (gross electricity consumed) from renewable sources by 2020. We are committed to ensuring that renewable energy is developed in a sustainable and considerate manner; one which lessens or negates any impacts on environmental or social and economic areas.

This document sets out a framework for the future development of the Pentland Firth and Orkney Waters marine spatial plan. It contains a summary of existing information on different uses of the seas, shows how these different uses may impact on each other and makes recommendations for future research to ensure that the plan is properly underpinned by relevant and good quality information. It sets out how the plan will be developed.

This document also sets out draft Regional Locational Guidance for the development of wave and tidal resources.

This document was originally published in draft format in March 2010, and was finalised following an informal public consultation in summer 2010.

INTRODUCTION

This document provides a Framework for the preparation of a Marine Spatial Plan (MSP) for the Pentland Firth and Orkney Waters. The purpose of the Framework is to define the overall three-stage process that we intend to use to develop the MSP. The document also presents the results of the first stage in that process, a baseline review of existing relevant information, identification of gaps in that information and recommendations on how those gaps should be filled.

This document incorporates the results of Regional Locational Guidance (RLG) for Marine Energy (wave and tidal stream) which is published as an Part 2 of this document.

In preparing an MSP all users of the sea and all aspects of environment must be considered. This Framework document therefore considers all sectors, and integrates the results of the RLG to provide more detailed consideration of the specific issues associated with marine energy projects.

Drivers for an MSP in the Pentland Firth and Orkney Waters

The Marine (Scotland) Act establishes a new marine planning system for Scottish waters. This new system will allow us to take a more strategic approach to managing our seas to balance resource needs spatially whilst protecting our marine environment. It is intended that Regional Marine Plans will provide the mechanism for resolving potential conflicts between different sectors and to allow key areas to be defined for specific uses.

The Pentland Firth and Orkney Waters have been identified as an area of Scotland with a significant renewable energy resource, in particular wave and tidal stream energy. The National Planning Framework for Scotland 2 (NPF2) notes the contribution that the area can make to energy generation and identifies electricity grid reinforcement as a national priority. The importance of renewable energy is also reflected in the Climate Change (Scotland) Act 2009 which creates a statutory framework for greenhouse gas reductions.

There is considerable interest in developing tidal and wave energy resources in the area and this has been given further impetus by the recent leasing round conducted by the Crown Estate Commissioners. This leasing round makes areas of the seabed available to developers to use the sea bed for wave and tidal

energy projects but they will then need to seek consent from Scottish Ministers to construct and operate their projects.

The Pentland Firth and Orkney Waters are of exceptional environmental quality and are a resource of importance to both national and local economies. Shipping, fishing, tourism and recreation are all integral to the local community's well being.

As such, the Scottish Government has acknowledged that there that there is a need to examine how future marine energy developments can be taken forward in this area in a manner that avoids conflicts with other users of the seas and which ensures that the marine environment is protected.

Ultimately, this would be achieved though the preparation and implementation of statutory regional marine spatial plans for the area. This will happen once the legislative framework for the development of regional marine spatial plans is in place. However, this will take time and there is a need to progress the process by providing guidance for the management of marine energy developments in Pentland Firth and Orkney Waters in advance of statutory plans for this geographic region being prepared. The development of this MSP in combination with the RLG aims to achieve this and will inform the future development of both the National Marine Plan and relevant regional plans.

In preparing an MSP all users of the sea and all aspects of environment must be considered. This Framework document therefore considers all sectors. It integrates the results of the RLG to provide more detailed consideration of the specific issues associated with marine energy projects.

SECTION 1: COVERAGE OF THE MSP FRAMEWORK AND STUDY AREA

Sectoral Coverage of the MSP Framework

This MSP Framework covers all marine sectors that occur (both currently and possibly in the future) within the Pentland Firth and Orkney Waters. However, it should be noted that the extent to which the individual sectors listed below can be managed through the MSP process is also influenced by other jurisdictional and regulatory controls. These are discussed in more detail in Section 2 Planning Context.

These marine and coastal sectors and activities include:

- § Community and the Economy
- § Environment and Heritage
- § Renewable Energy
- § Shipping and Navigation
- § Ports and Harbours and Other Infrastructure
- § Commercial Fishing and Mariculture
- § Tourism and Recreation
- § Oil and Gas and Aggregate Extraction
- § Defence

Geographical Coverage

Geographically, this MSP Framework covers the Pentland Firth and the waters around Orkney, from the mean high water mark out to the 12 nautical mile territorial limit. The geographical coverage is illustrated on Figure 1. Interactions beyond this boundary are considered as part of the study.

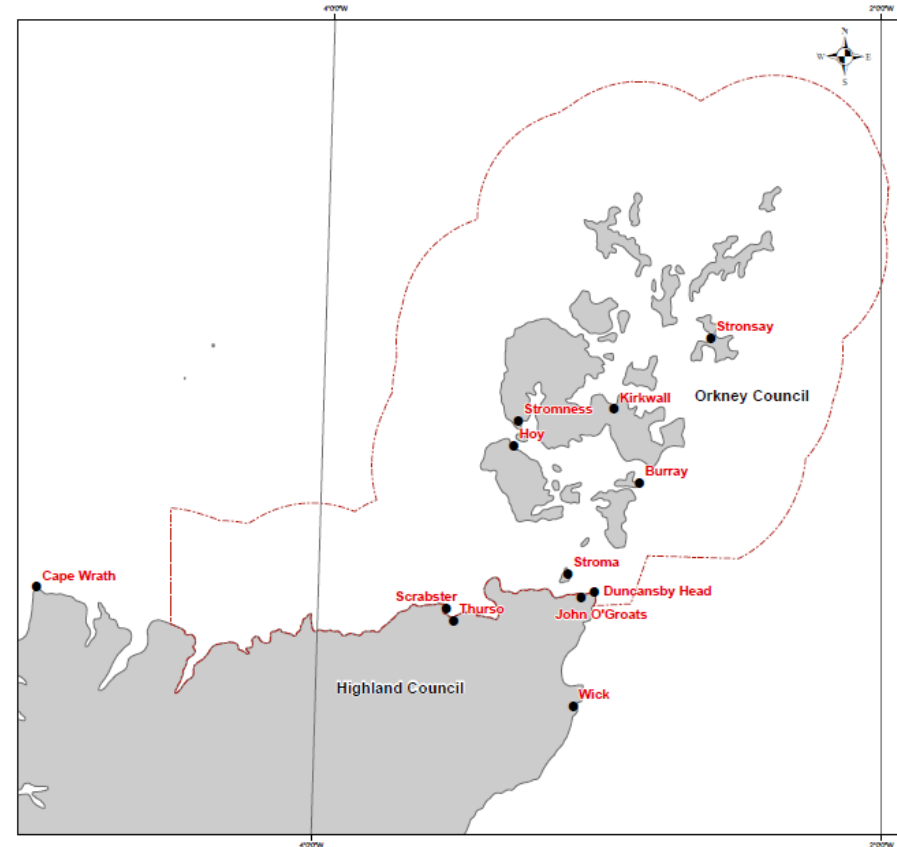
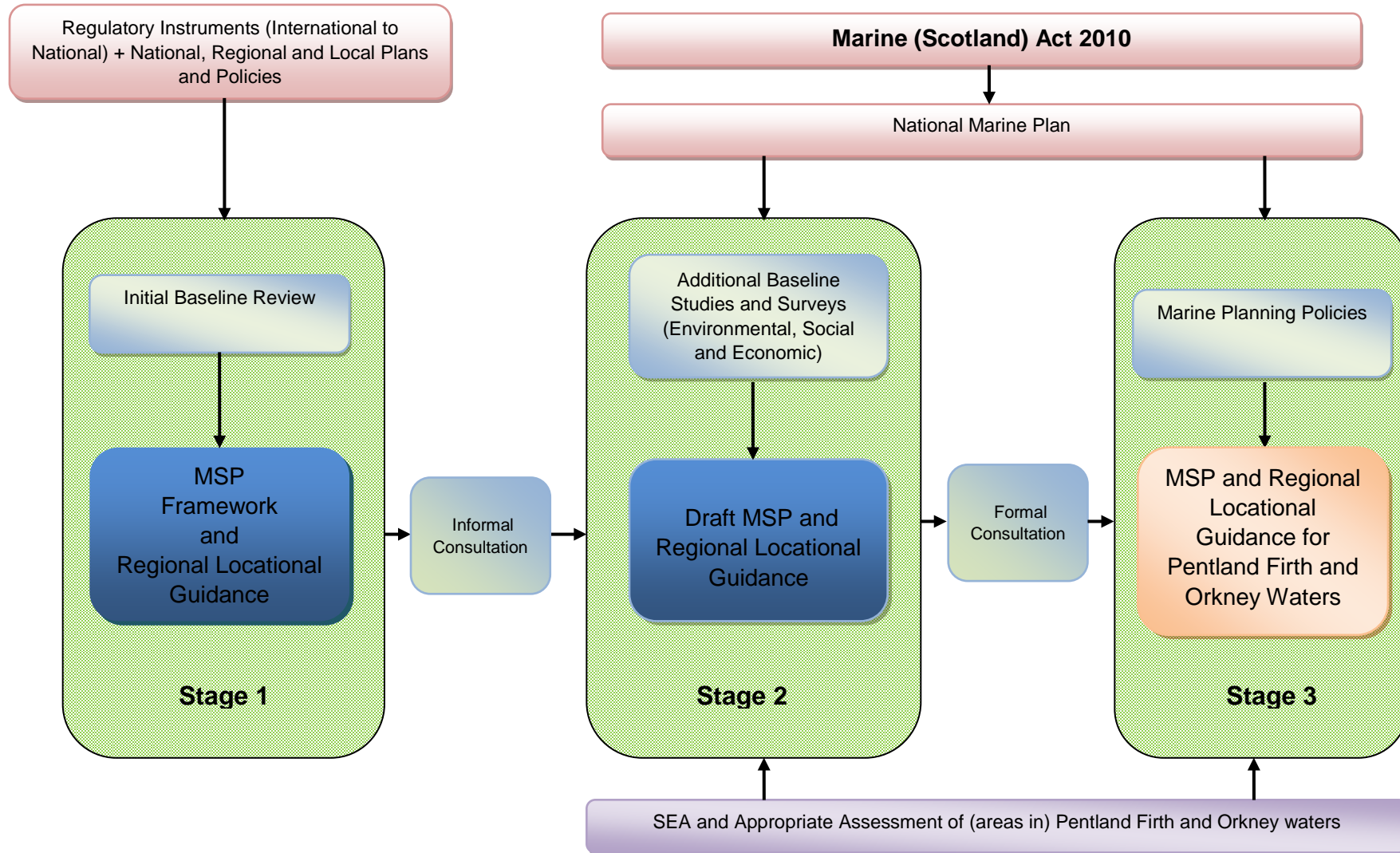


Figure 1.1: Study Area

SECTION 1: PREPARATION OF THE MSP FRAMEWORK

Diagram 1.1: MSP Framework and RLG Route Map

Diagram 1.1 below illustrates how the preparation of this MSP Framework and the Regional Locational Guidance (RLG) for wave and tidal stream projects, relates to the overall process for the preparation of the final MSP for the Pentland Firth and Orkney Waters. The MSP is being prepared in 3 stages as shown. Stage 2 involves further baseline studies, research and analysis to provide the evidence for the preparation and adoption of the MSP in Stage 3.



SECTION 1: AIMS AND OBJECTIVES OF THE MSP FRAMEWORK AND RLG

Aim of the MSP Framework

The main aim of this MSP Framework is to provide guidance and direction for the preparation of the future MSP for the Pentland Firth and Orkney Waters.

Objectives of the MSP Framework

The main objective of this Framework document is to set out the process for developing the future MSP and identify the information that is needed to underpin that MSP. The Framework summarises existing knowledge of the use of this geographic area and identifies priorities for future work to fill identified information gaps.

Future work on developing the MSP will build on this to develop priorities as shown in this diagram:

§ The current situation (Pentland Firth and Orkney Waters)

- ∅ Describing the main characteristics of current and future marine sectors and activities.
- ∅ Identifying the key issues associated with the different main marine sectors and activities.
- ∅ Examining the interactions and overlapping interests between current and future marine sectors and activities.

§ Future growth and change

- ∅ Identifying strategic issues for growth/change.

§ Priorities and Actions

- ∅ Identifying priorities for policy development for the future statutory MSP
- ∅ Identifying the actions necessary for delivering strategic priorities through the Statutory MSP Process e.g. additional studies/assessments.
- ∅ In doing the above, identifying opportunities for managing overlapping interests and ensuring consistency between the MSP Framework and the land use planning system (Highlands Local Plan and Orkney developments plans).

Aim of the Regional Locational Guidance (RLG)

The main aim of the Regional Locational Guidance (RLG) is to provide guidance and advice to marine renewable energy developers and other stakeholders on the siting of wave and tidal developments in the Pentland Firth and Orkney Waters. The RLG is published separately but because its results are integrated into the MSP Framework its objectives are also set out here.

Objectives of the RLG

The main objectives of the RLG include:

§ The current situation

- ∅ Reviewing current and emerging technologies and development parameters.
- ∅ Identifying areas of wave and tidal resource and development zones.

§ Development guidance

- ∅ Developing criteria/guidance for developers in order to increase the acceptability of their proposals in respect to other marine sectors. This will include:
 - Generic guidance (within Pentland Firth and Orkney Waters).
 - Zone/location specific guidance
 - Highlight issues to be addressed for multiple wave & tidal developments.
 - Highlight requirements for other infrastructure required to support the industry.

§ Coordinating and managing uncertainty

- ∅ Examining how overlapping interests can be managed in a way that can be agreed by all stakeholders.
- ∅ Identifying opportunities for co-operation between developers and land side activities.
- ∅ Examining options for data sharing and research and the deploy and monitor process.

CONSULTATION

The preparation of both the Framework for the MSP and RLG has been based on a combination of consultation and technical analysis. The two processes work in tandem with one informing the other. Consultation ensures that all organisations with responsibilities for the management of activities within marine areas are given the opportunity to be actively involved in the development of the MSP.

One of the challenges for marine spatial planning is to link into land use planning activities and establish an integrated approach to the use, development and protection of resources across the land/ sea interface. As explained in Section 2 below, the local authorities are currently in the early stages of preparing Local Development Plans (LDPs) and in the case of Highland Council a Coastal Development Strategy is in preparation. As these plans are being prepared to similar timescales there has been an opportunity to link the preparation of the LDP to MSP processes.

The main consultation activities undertaken to date are summarised in Table 1.1. The results of consultation have been incorporated in to the summary of Strategic Issues set out in Section 4 below.

Table 1.1: Summary of Consultation Activities

Main Consultation Groups	How they will be Consulted
Local Government (Highlands and Orkney Councils)	The Councils assisted with and/or organised workshop events in Kirkwall and Thurso. These events were attended by a wide range of stakeholder groups. One-to-one meetings were held with Council officers to discuss specific issues of interest.
Governmental Agencies and the Crown Estate Commissioners	One-to-one meetings were held to discuss specific issues of interest. Representatives of these organisations attended workshop events.
Non-governmental organisations	Representatives of these organisations attended workshop events.
The private sector	One to one meetings were held. Key participants included the marine energy sector and harbour trusts. Representatives of other private sector organisations attended workshop events. These included fisheries interests, tourism interests, the Chamber of Commerce and large employers including Dounreay. The Scottish Renewables Forum has been involved the through Scottish Government/ Marine Scotland and Marine Energy Spatial Planning Group (MESPG).

SECTION 2: PLANNING CONTEXT

MARINE PLANNING

Marine spatial planning is recognised as the mechanism for achieving a more integrated, simplified and sustainable approach to the management of marine sectors and activities and increased protection of the natural marine and coastal environment.

The marine planning process, which has been tested as part of pilot schemes, integrated coastal zone management and sustainable seas initiatives over the last few years has recently been made statutory for UK waters through the UK Marine and Coastal Access Act, which received Royal Assent in November 2009.

In 2008, the Scottish Government published its consultation document 'Sustainable Seas for All: A Consultation on Scotland's First Marine Bill'. This document set out the Scottish Governments proposals for the preparation of a Scottish Marine Bill including provisions for marine planning in Scottish waters. The resulting Marine (Scotland) Act has now received Royal Assent.

Proposals for Marine Planning in Scotland

It is proposed that marine planning in Scotland will be based on a 3-tier system:

- § Scotland (National) Level Planning
- § Regional Level Planning
- § International Level Planning

Scotland (National) Level Plans

There will be a single Scottish National Marine Plan. This plan is being prepared by Marine Scotland and will set national economic, social and marine ecosystem objectives alongside objectives relating to the mitigation of, and adaptation to, climate change. In preparing the plan, a summary of significant pressures is being compiled and an assessment of the condition of the Scottish marine area has been carried out (published as the Marine Atlas; www.scotland.gov.uk/marineatlas). The purpose of the plan is to state Scottish Minister's policies for, and in connection with, sustainable development of Scottish waters. This will reflect requirements in relation to the UK Marine Policy Statement as well as others in relation to international and European obligations

and commitments including the Marine Strategy Framework Directive (MSFD), OSPAR and Habitats Directive, in addition to sector specific policies.

The National Marine Plan may set out specific spatial requirements for particular types of activity or development where these are of national significance. The pre-consultative draft of the National Marine Plan will be published in March 2011. Regional plans must be in conformity with the national marine plan.

Regional Level Plans

It is intended that regional level plans will be prepared for Scottish Marine Regions (SMRs) to take forward policies and priorities defined in the National Marine Plan. These regions will be defined by Scottish Ministers (following a public consultation which took place in Winter 2010/11). It is intended that a Marine Planning Partnership (MPP) will be defined for each region and will comprise representatives from the main stakeholder interests in the area including Local Authorities. The MPPs will also be responsible for the preparation of a regional marine plan for their area.

Both the national and regional marine plans will be formal planning documents and will consequently be a material consideration in the determination of development consents and licence applications. Marine plans are likely to include (at the relevant scale):

- § Identification of key issues currently affecting the marine environment.
- § A vision for the marine area covered by the plan.
- § Objectives for the management and protection of the marine environment.
- § Strategic objectives for growth and development of marine sectors/activities.
- § Action plan for delivering strategic priorities.
- § Management policies for specific sectors and activities.
- § Policies for the protection of the marine environment.
- § A framework for decision making in respect to development consents.
- § Guidance on taking nature conservation measures into account in the decision making process and the implementation of local nature conservation objectives and measures.
- § Identification of certain areas for development or use by certain sectors/for certain activities.
- § Links to the land use planning system and other plans.

SECTION 2: PLANNING CONTEXT

With respect to preparation of a Plan, The Marine (Scotland) Act 2010 requires the following:

For the purposes of preparing a national marine plan or (as the case may be) a regional marine plan, the Scottish Ministers must—

(a) set—

(i) economic, social and marine ecosystem objectives,

(ii) objectives relating to the mitigation of, and adaptation to, climate change,

(b) prepare an assessment of the condition of the Scottish marine area or, as the case may be, Scottish marine region at the time of the plan's preparation,

(c) prepare a summary of significant pressures and the impact of human activity on the area or region.

The Act incorporates **the ecosystem approach**, a concept that is now widely used by international, EU governments and institutions and conservation groups. The Scottish Government publication Sustainable Seas for All defines the Ecosystem Approach as an '*integrating and managing the range of demands placed on the natural environment in such a way that it can indefinitely support essential services and provide benefits for all*'.

International Level Plans

The focus at the international level would be to set plans and policies relating to Scottish Waters within the wider UK, European, North Atlantic and global frameworks. These frameworks and related obligations and commitments will ultimately underpin both the national and regional level plans and other related plans and programmes including land use plans. The UK wide Marine Policy Statement has particular significance in that, if it is adopted by Scottish Ministers, it will have statutory effect in relation to both marine plans and enforcement and authorisation decisions.

Existing Regulatory Controls and Jurisdictional Matters

Whilst the MSP process aims to cover all marine sectors and activities, it must be recognised that there are a number of existing regulatory controls, legislative regimes and jurisdictional matters that influence the extent to which the marine planning process can actually control or manage certain sectors and activities at sea. The level of responsibility will be reflected in the policies which are contained within the future MSP.

Existing Legislation and Regulatory Mechanisms

There are a number of existing legislative controls and regulatory mechanism for the marine environment that influence the content of this MSP Framework and associated Regional Locational Guidance (RLG) e.g. compliance with EU Habitats and Birds Directives.

There are also a number of legislative controls and regulatory mechanisms that are currently used to control the effects of a range of marine activities on the marine natural environment and other marine users e.g. navigation. These will continue to be applied under the existing, and any future, legislative frameworks and regimes e.g. the control of discharges to the marine environment will continue to be controlled through the Water and Environment Controlled Activities Regulations (CAR) 2005. It is therefore not the role or responsibility of the MSP process to reproduce or replicate these existing regulatory controls.

SECTION 2: PLANNING CONTEXT

Jurisdictional Matters

At present, activities within the Scottish seas are regulated by more than 80 pieces of legislation and three different parliaments. The Scottish Government has devolved responsibility for the majority of activities that occur within 12 nautical miles (nm). However, in addition to the existing legislative regime and regulatory controls there are also some jurisdictional matters that influence what the MSP can and cannot deliver. These are summarised in Table 2.1.

Table 2.1 Jurisdictional Coverage of MSP

Sector	Scottish Government Responsibility	What MSP policies can deliver
Environment and Heritage	Devolved	Provide additional protection e.g. through designation of Marine Protected Areas (MPAs). Assist in achieving the objectives of the MSFD (but not primary mechanism for implementing MSFD). Assist in applying ecosystem approach to management of natural environment. Ensure consistency with land use planning policies relating to the environment and heritage. Ensure development is controlled in a manner that is consistent with environmental legislative requirements.
Renewable Energy	Executively Devolved	Allocate and prioritise space for marine energy developments. Identify criteria against decisions will be made to consent development to ensure that other policy objectives are not compromised.
Shipping and Navigation	Reserved	Can allocate and prioritise for shipping activities with UK Government and industry agreement. Seek to implement management measures to accommodate other development in consultation with UK Government and IMO etc.
Ports and Harbours	Devolved	Activities and developments within harbours fall within the jurisdiction of the Harbours Authority who should have regard to marine plans in exercising their functions.

SECTION 2: PLANNING CONTEXT

Table 2.1 Jurisdictional Coverage of MSP (continued)

Sector	Scottish Government Responsibility	What MSP policies can deliver
Other Infrastructure	Devolved	There is a wide range of other infrastructure which may exist or be developed within the marine environment. The responsibility for this will depend on the type of infrastructure and its location (e.g. above or below mean high water mark) e.g. grid infrastructure and coastal defences. The marine spatial plan will seek to provide an overall strategic policy lead to ensure consistent development across the land-sea (mean high water mark) boundary
Commercial Fishing	Devolved	It is not the purpose of the MSP to control the commercial or operational activities of the fishing industry e.g. quotas or methods. The MSP will influence the location of development and how fishing interests should be taken into account in decisions making.
Mariculture	Devolved	Mariculture development within 3nm of the coast falls under the jurisdiction of the local planning authority. It will be necessary for the MSP to reflect the policies of the local authorities to ensure a consistent approach to spatial planning. Development beyond 3nm will be the responsibility of the MSP.

Sector	Scottish Government Responsibility	What MSP policies can deliver
Tourism and Recreation	Devolved	There is a wide range of activities related to recreation and tourism that may exist or be developed within the marine environment. The responsibility for this will depend on the type of infrastructure or activity and its location e.g. marinas. As with other activities, the marine spatial plan will seek to provide an overall strategic policy lead to ensure consistent development across the land-sea (mean high water mark) boundary.
Oil and Gas and Telecommunications	Reserved	Existing and future facilities may need to be accommodated within the area. It is the role of the MSP to take these into account when planning for other marine developments.
Defence	Reserved	Identify relevant activities and determine their likely interaction with others covered in the plan.

SECTION 2: PLANNING CONTEXT

NATIONAL AND LOCAL PLANNING CONTEXT

Marine spatial plans relate to the use, and protection of, both the marine and coastal environment. It is therefore necessary to consider the preparation of a future Marine Spatial Plan for the Pentland Firth and Orkney Waters in context of existing and emerging land use plans and policies for the area. This includes both national and local level plans.

In 2006 the Scottish Government introduced the new Planning etc. (Scotland) Act. This Act, which amends the Planning (Scotland) Act 1997, aims to modernise the planning system to make it more responsive to different types of development (e.g. from major developments of national importance to minor developments e.g. house extensions), more efficient in terms of determining planning applications and developing land use plans, facilitating increased public consultation and community engagement and improved enforcement and monitoring of conditions.

National Planning Framework

One of the key requirements of the Act is the preparation of a National Planning Framework (NPF) for Scotland. NPF for Scotland 2 (NPF2) was issued in December 2008. This document, which was updated to reflect the requirements of the Planning etc. (Scotland) Act, sets out national strategic development policies and investment priorities for Scotland. It also includes guidance for the designation of 'national projects' and specific procedures for considering such developments.

NPF2 sets out the Future Development Strategy for Scotland 2030. This strategy recognises the importance of the marine and coastal environment of Scotland and the need for the planning system to help improve the protection of marine wildlife and ensure that marine resources are developed and managed in a sustainable way. The NPF2 also includes specific reference to the development of renewable energy and grid infrastructure.

NPF2: Renewable Energy

The NPF2 acknowledges that the Scottish Government's target of generating 50% electricity used in Scotland from renewable sources by 2020 is likely to be met (in September 2010 this target was increased to 80%) and highlights Scotland's commitment to deriving 20% of the total energy use from renewable sources by 2020 in line with EU Targets.

It also reinforces the Scottish Government's commitment to establishing Scotland as a leading location for the development of renewable energy technologies and as an energy exporter over the longer term. It sets out that this will be achieved with a mix of renewable energy technologies including marine renewable energy and offshore wind, and places particular emphasis on realising the potential of harnessing the significant tidal energy resources located off the north and west coasts of Scotland (e.g. Pentland Firth) whilst safeguarding the environment and communities.

The NPF2 recognises the importance of the continued contribution of the European Marine Energy Centre (EMEC) at Stomness to the development of marine energy technologies and the need to reinforce the existing electricity grid infrastructure in the highlands and islands and across Scotland to realise the full potential of renewable energy resources.

SECTION 2: PLANNING CONTEXT

Local Land Use Plans

Under the Planning etc. (Scotland) Act 2006, both the Orkney Island Council and Highland Council have commenced preparation of their Local Development Plans which, once adopted, will replace their existing structure and local plans. Both Councils have recently published their Draft Main Issues Reports. A summary of these is provided below.

Orkney Local Development Plan – Main Issues Report

Orkney Island Council has recently commenced work on the preparation of the new Orkney Local Development Plan. The Plan, which is estimated to take up to 3 years to complete, will establish a vision for what Orkney will look like in 20 years time and will set out a broad direction for development for the next 10 years with firm proposals for the next 5 years.

Preparation of the Main Issues Report is the second formal stage in the 3 year process, following preparation of the Development Plan Scheme in August 2009. The Main Issues Report is a main part of the consultation process and will be used to set the firm direction for Council policy on planning matters for the next five years and beyond.

Within the Draft Main Issues Report, Orkney Council presented its preferred options for the long term vision for Orkney, the policies and proposals from the existing plan where it is expected that there will need to be a significant change of direction (main issues) and policies and proposals that need to be updated to reflect current national planning policy.

In terms of this MSP Framework, Orkney Council has identified under Main Issue 3: Planning for Economic Development that in order to establish an ambitious vision for sustainable growth and development in Orkney the correct settings for business development need to be created. In achieving this, the Council propose to establish four new policy areas including Renewable Energy Opportunities – Onshore Wind and Marine Energy Development.

With regard to Renewable Energy Opportunities the Council recognises the need to give special attention and focus on developing appropriate policy to support the continuing growth and expansion of this industry within Orkney and to ensure that the island is able to respond to the scale of the priority placed on developing this industry in Scotland.

This includes developing appropriate policy to address the provision of necessary land based infrastructure to support offshore activities e.g. grid, port upgrades. However, any future policies that are developed in respect to renewable energy opportunities will have to be set within the wider framework of, and be consistent with, existing and future policy on environmental protection, in particular protection of the marine and coastal environment and other marine activities and users e.g. mariculture, port and harbours, recreation and tourism, historic environment and heritage.

In addition, the Main Issues Report sets out other policy objectives of relevance to the MSP including the protection of the environment, mariculture and climate change.

Highland Wide Local Development Plan – Main Issues Report

The Highland Council published their Main Issues Report for consultation on 1st September 2009. As with the Orkney Local Development Plan, The Highland Wide Local Development Plan sets out a vision and strategy for the highlands of Scotland over the next 20 years including options for delivering development in the region.

The Main Issues Report is the formal second stage in the preparation of the Local Development Plan. Rather than replacing the existing structure plan, the focus for this Local Development Plan is on tackling new issues and concentrating on topics and areas where change is required and can occur. The focus for the Main Issues Report is to therefore explore a number of options for tackling issues or facilitating change and to consult the local population and communities on how the region should change.

The Main Issues Report sets out a proposed vision for the region and establishes a number of plan objectives to deliver that vision. The Main Issues Report also sets out spatial strategies for Inverness and the A96 Corridor, Caithness and Sutherland, Easter Ross and Nigg, Local Centres across the Highlands and the wider countryside and fragile areas.

As part of the Caithness and Sutherland spatial strategy the Main Issues Report highlights the importance of the huge tidal energy resource within the Pentland Firth and the opportunities for the long term development of this energy resource as identified in the NPF2. The Main Issues Report highlights the need for the Local Development Plan to enable and support the delivery of onshore facilities,

SECTION 2: PLANNING CONTEXT

services and sites to ensure that the inward investment opportunity associated with the growth of this industry is capable of being delivered.

This is seen as being particularly important, both in terms of responding to the national priority set out in NPF2 to place Scotland at the forefront of developing and exporting marine renewable energy, and tackling more local issues relating to regeneration and the decommissioning of the Dounreay nuclear site which has been a major source of employment in this area for 50 years.

The Highland Council has developed a preferred option for dealing with the issues identified for Caithness and Sutherland. This includes putting in place policies which support the growth of marine renewable energy in the Pentland Firth and the facilities and industry required to support them.

As with the Orkney Local Development Plan any future policies that are developed in respect to renewable energy opportunities will have to be set within the wider framework of, and be consistent with, existing and future policy on environmental protection, in particular protection of the marine and coastal environment and other marine activities and users e.g. port and harbours, recreation and tourism, and the historic environment and marine heritage.

Highland Council Coastal Development Strategy (Draft)

Highland Council are producing a Coastal Development Strategy and have prepared a report classifying the Highland coast for planning purposes as recommended in National Planning Policy Guideline (NPPG) 13. The extract from the draft document below sets out the strategy for the North Coast of the Highlands.

Highland Council Strategy for the North Coast:

Counter the issues of remoteness, exposure and relatively low visitor numbers by playing to this coast's strengths. These are unspoilt and distinctive coastal scenery, strong energy infrastructure and potential for harnessing tidal power, ready access to northern fishing grounds and the Orkney Isles, coastal wildlife interest, high-quality surfing and diving and by promoting the area more vigorously.

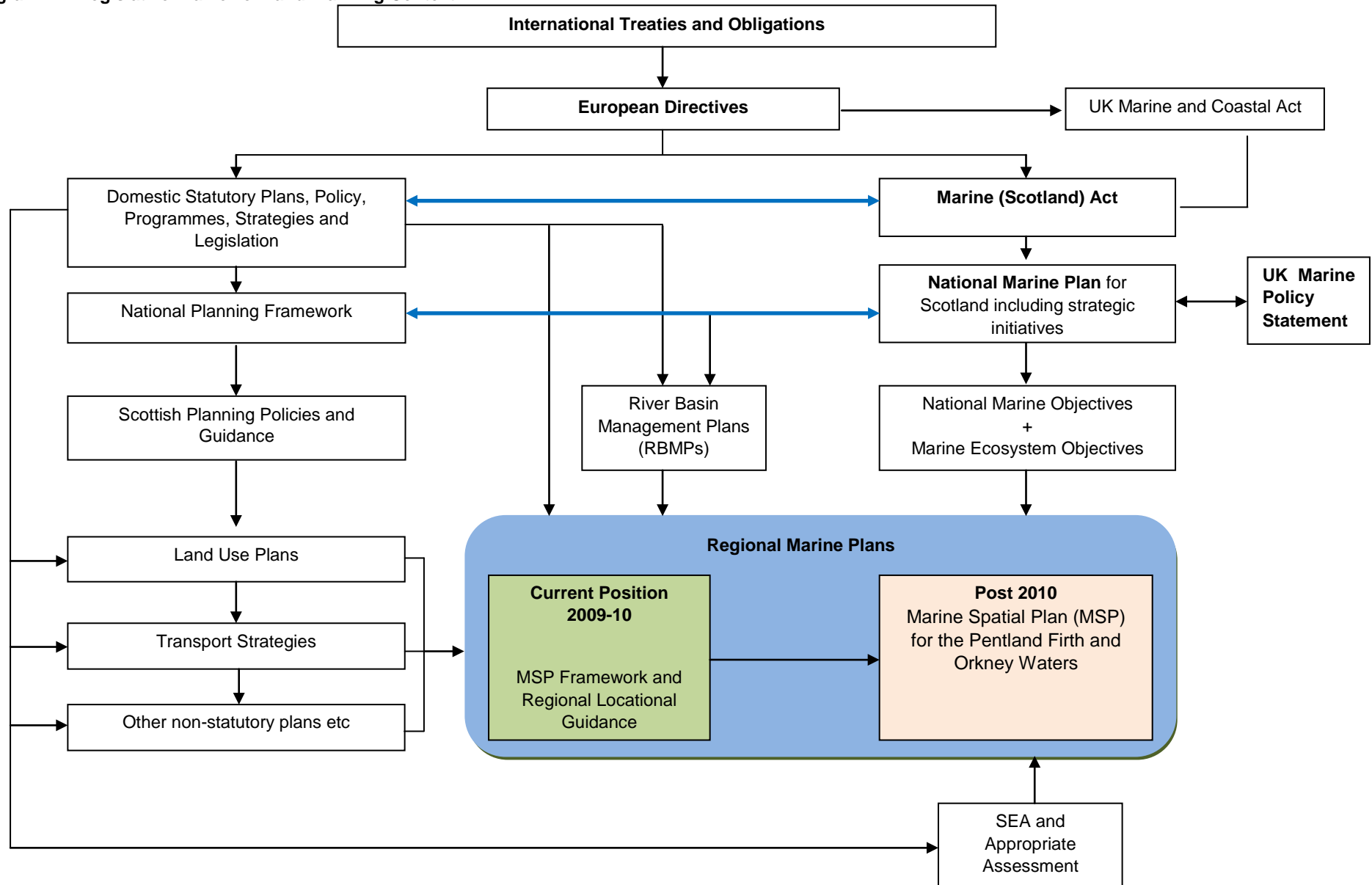
- § Help local businesses to grow within spatially-defined communities by supporting development that does not detract from the immediate coastline, e.g. onshore support for renewable energy industry;
- § Support redevelopment of John O'Groats to make it a more memorable visitor destination;
- § Capitalise on the fine panoramic coastal viewpoints provided by the major North Coast headlands by supporting development of appropriate visitor facilities at Dunnet Head and Duncansby Head;
- § Encourage more provision for water-based recreation activities at suitable coastal locations, e.g. Dunnet Bay, Skerry, Loch Eriboll;
- § Protect the integrity of designated wildlife and heritage sites and high value landscape areas by discouraging inappropriate development and applying suitable design standards;
- § Support the development of renewable energy in appropriate sites, e.g. Pentland Firth, Thurso Environmental Research Institute.

Other Plans and Legislation

There is a multitude of other plans, legislation and obligations relating to the marine environment that have an influence on activities which take place in the marine environment. Each of these will need to be considered in preparing the statutory MSP. Diagram 2.1 below illustrates the relationship between this MSP Framework and the RLG and other international and European obligations and commitments that are relevant to the marine environment and other national, regional and local plans, programmes and policies.

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Diagram 2.1: Legislative Framework and Planning Context



SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

INTRODUCTION

This section provides a very brief overview of the study area. **The text is accompanied by a number of figures. More baseline figures (including larger format figures) can be found in Appendix A.**

The Pentland Firth is a stretch of water that joins the North Atlantic to the North Sea, separating Orkney from the north coast of mainland Scotland. Caithness and Sutherland are the most northern counties in mainland Scotland. Caithness covers the most north east section of mainland Scotland from Dunnet Head in the north to the Ord of Caithness in the south¹. Sutherland extends across northern Scotland from stretch of east coast which extends between Dornoch and Helmsdale, to Lochinver and Assynt on the west coast, northwards to Cape Wrath and the Sutherland north coast east to the border with Caithness.

In comparison the Orkney archipelago comprises approximately 70 islands, of which only 21 are inhabited throughout the year. In total the islands cover an area 974km² and are spread across 85km from north to south and 37km east to west. With 1,246km of coastline, nowhere in Orkney is more than 20km from the coast.

COMMUNITY AND ECONOMY

Population and Local Communities

In 2007 the population of Orkney was estimated to be 19,860² with approximately 50% living in the main towns of Kirkwall and Stromness on the mainland. The remaining population is distributed across smaller local centres, villages and rural settlements on the mainland and surrounding islands. Of the islands that are inhabited throughout the year the larger populations are found on Burray and South Ronaldsay. There are also a number of communities on Hoy, Shapinsay and Rousay as well as some of Outer Isles of Sanday, Westray, Papa Westray, Stronsay, Eday and North Ronaldsay².

The population in Caithness and Sutherland is estimated to be 40,000 with a large proportion of the population distributed across the main towns of Wick and Thurso (Caithness) and along the east and west coasts of Sutherland. The rest of the

population is distributed amongst smaller villages and settlements in coastal areas including Tongue, Bettyhill and Melvich on the north coast.

The main settlements along the north coast include Reay, Scrabster, Castletown, Dunnet and John O'Groats. The population inland is very sparse making the area one of the least densely populated areas in Europe¹.

Local Economy

The local economy of Orkney has traditionally been based around agricultural and fishing industries. More recently the public sector is the largest employer and there has been significant growth in other sectors including tourism, mariculture and renewable energy. Shipping and navigation are important sectors and the Flotta oil terminal has made a significant contribution to Orkney's economy. Orkney has significant marine and wind energy resource due to its exposed location. With the European Marine Energy Centre (EMEC), Orkney has established itself as one of the world's leading centres for testing wave and tidal generation technologies. The Crown Estate Commissioners recently leased several sites around the islands to developers for commercial wave and tidal developments. Tourism is an established and increasing contributor to the Islands' economy, due to Orkney's unique natural and cultural heritage. Other important employers include food and drink manufacturing, arts and crafts.

In comparison the local economy of Caithness and Northern Sutherland has been strongly influenced by the Dounreay nuclear site which at its peak employed 3500 people. The number of people employed at the site has been reducing steadily over the last few years following its decommissioning. However, it is likely that decommissioning will take a number of years and will continue to be a source of employment for people in Caithness, in particular residents of Thurso on the north coast.

The Caithness and Northern Sutherland economy is also dependent on tourism to supplement the more traditional industries of farming, forestry, fishing (in particular herring) and the production of flagstones. However, in recent years there has been an increase in the growth of hi-tech industries. These have been built around the local skills and expertise gained from the operation of Dounreay. The harbours at Scrabster and Wick provide important transport links to the area and support related sectors including fishing, cargo, ferries and cruise liners, offshore renewable energy and services to the oil and gas industry.

¹ <http://www.caithness.org/geography/>

² Orkney Population Change Study: Executive Summary (Hall Aitken April 2009)

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

ENVIRONMENT AND HERITAGE

The waters within the Pentland Firth and around the Isles of Orkney support a rich and diverse marine and coastal wildlife as well as a range of important natural features of high scenic and/or historic value. These waters and the surrounding coastline, and the wildlife and natural features they contain and support, are also interlinked with other marine sectors such as fisheries and tourism.

The key elements of the marine and coastal natural environment that are covered in this MSP Framework include:

- § Nature conservation and biodiversity including:
 - ∅ Protected sites and species
 - ∅ Marine Protected Areas (MPAs)
 - ∅ Local designations
- § Bathymetry, Geology and Geomorphology and Coastal Processes
- § Seascape and landscape
- § Archaeology and built heritage
- § Water quality
- § Air quality
- § Climate and climate change

Baseline figures are included within the text with further figures contained in Appendix A.

Protected Sites and Species

Marine and Coastal Habitats

The Pentland Firth and sea around the Isles of Orkney are rich in biodiversity and support a range of valuable, and often rare or vulnerable, species and habitats. Some of the key habitats known to be present in the marine and coastal waters around Orkney and within the Pentland Firth range from important submerged reefs, tidal rapids and meadow beds to sandbanks and salt marshes, dune systems (including the rare machair) and maritime heath and grasslands.

A number of these marine and coastal habitats are listed under Annex I of the EC Habitats Directive (92/42/EEC) and have been afforded protection through the designation of Special Areas of Conservation (SACs). In total there are three SAC sites on Orkney and four SAC sites on the Caithness Coast designated for the protection of marine and coastal habitats.

In addition to SAC designations, a number of these maritime and coastal habitats are also protected under National Legislation through the designation of Sites of Special Scientific Interest (SSSI). In total there are 22 SSSIs on Orkney and along the North Caithness coast designated for maritime and coastal habitats.

There are also a number of marine and coastal habitats that are recognised as being important (priority) species on the UK Biodiversity Action Plan (UKBAP) list. Although these habitats are not covered by any specific designations, a number of them are included within the SAC sites and their presence on the UKBAP Lists requires their range and abundance to be protected and maintained.

Birds

The Caithness and Orkney coastlines are internationally important, supporting extensive colonies of migratory and breeding seabirds including Atlantic puffins, black-legged kittiwakes, Arctic skuas and Arctic terns, razorbills, northern fulmars, common guillemots, storm petrels, northern divers, Slavonian grebes and greater black-backed gulls. Sule Skerry and Sule Stack, which are located 60km off the Orkney mainland, also support colonies of European shag. In addition, the only colony of gannets in the region is located on Sule Stack. The coastal areas, in particular saltmarsh and wetland areas also support wading birds, both overwintering and breeding.

Rare and vulnerable birds are listed under Annex I of the European Birds Directive (79/409/EEC) and are afforded protection through the designation of Special Protection Areas (SPAs). There are 13 SPAs in Orkney of which 10 have been designated for seabirds (migratory species and breeding colonies) and two are designated for wading birds, one of which (East Sanday) is also designated as a Ramsar site under the international convention on the protection of wetlands and waterfowl.

Of the 10 Orkney SPAs designated for migratory and breeding seabirds, seven have recently been extended 2km offshore to cover important offshore feeding and loafing habitat. Seaward extensions have also been applied to two of the SPAs on the North Caithness Coast (Cape Wrath and the North Caithness Cliffs).

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Although these are the only SPAs on the North Caithness Coast, the North Caithness Coast SPA extends along a large stretch of the north coast which is also covered by five separate SSSIs which, in addition to the protection of maritime and coastal habitat, are also designated for seabird species.

Marine Mammals and Reptiles

The waters of the Pentland Firth and Isles of Orkney support a wide range of marine mammals (seals, dolphins, whales and porpoise). The waters around Scotland, including the north coast and Orkney, are recognised as being important for populations of seals, with approximately 43% of Europe's common seal population and 85% of Europe's population of grey seals. There are a number of seal breeding and haul out sites around the Isles of Orkney. Two of which have been designated as SACs for breeding colonies, one for grey seals, the other for common seals. Although there are no specific SACs designated for seals along the North Caithness coast, there is a large grey seal colony located at Dunscauby Head. Seals from this colony are likely to be present in the Pentland Firth.

The harbour seal population around Orkney has seen a rapid decline in recent years. The cause of this decline is uncertain but additional potential impacts will be of concern.

Whales, dolphins and porpoises are also frequently sited in the Pentland Firth and waters around the Orkney Isles. These are all identified as species of European Community interest and are afforded protection under Annex IV of the Habitats Directive. They are also all protected under the Wildlife and Countryside Act (1981). Bottlenose dolphins and harbour seals are also listed under Annex II of the Habitats Directive, which requires SACs to be designated for them. However, although harbour seals are present in the area, no formal SACs currently exist for this species.

There has also been sightings of leatherback and other turtles in the area. Most of these were recorded to the north of Orkney during late summer and early autumn.

A summary of the current status of key species will be included as part of the studies taken forward in Stage 2.

Fish and Shellfish

Scottish waters are estimated to support 250 fish species, a number of which are known to be present in the Pentland Firth and waters around Orkney. Many of the

species present are listed, including the native oyster, cod and haddock, are listed on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species. Common skate, basking shark and native oyster are also listed as UKBAP species.

The waters around Orkney are also important spawning grounds for herring and important nursery grounds for sandeels and other species including *Nephrops*. Sandeels are an important food source for both commercial fish species such as cod, haddock and whiting and are also an essential food source for seabirds and mammals. It is thought that the declines in the populations of sandeels have contributed to fluctuations in puffin numbers within the area.

Marine Protected Areas

In delivering OSPAR's biodiversity strategy the Scottish Government is committed to establishing an ecologically coherent and well-managed network of Marine Protected Areas (MPAs) by 2012. The network of MPAs will comprise SACs and SPAs designated under the Habitats Directive and new national Marine Protected Areas which will be designated under the Marine (Scotland) Act. One of the aims of the national MPAs will be to recognise nationally important species and habitats.

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Local Designations

It is proposed within the Orkney Local Development Plan Key Issues Report that, in line with Scottish Planning Policy, the Council will consolidate existing local designations for the protection of landscape and natural heritage into two main categories: Special Landscape Areas (see landscape section below) and Local Nature Conservation Sites.

It is proposed that, although the majority of the existing sites within Orkney will remain the same, some additional sites have been identified. The boundaries for these sites are currently being finalised and will be subject to consultation with landowners prior to their inclusion in the Proposed Plan.

Additionally, the Council, in line with Scottish Planning Policy, is proposing that it will no longer classify different coastal areas (e.g. Isolated Coast, Undeveloped Coast and Developed Coast) as it does in the existing Local Plan. The Council considers that the designation of Special Landscape Areas will offer adequate protection to coastal areas at the local level.

Further spatial information on protected areas and species can be found on the SNH website

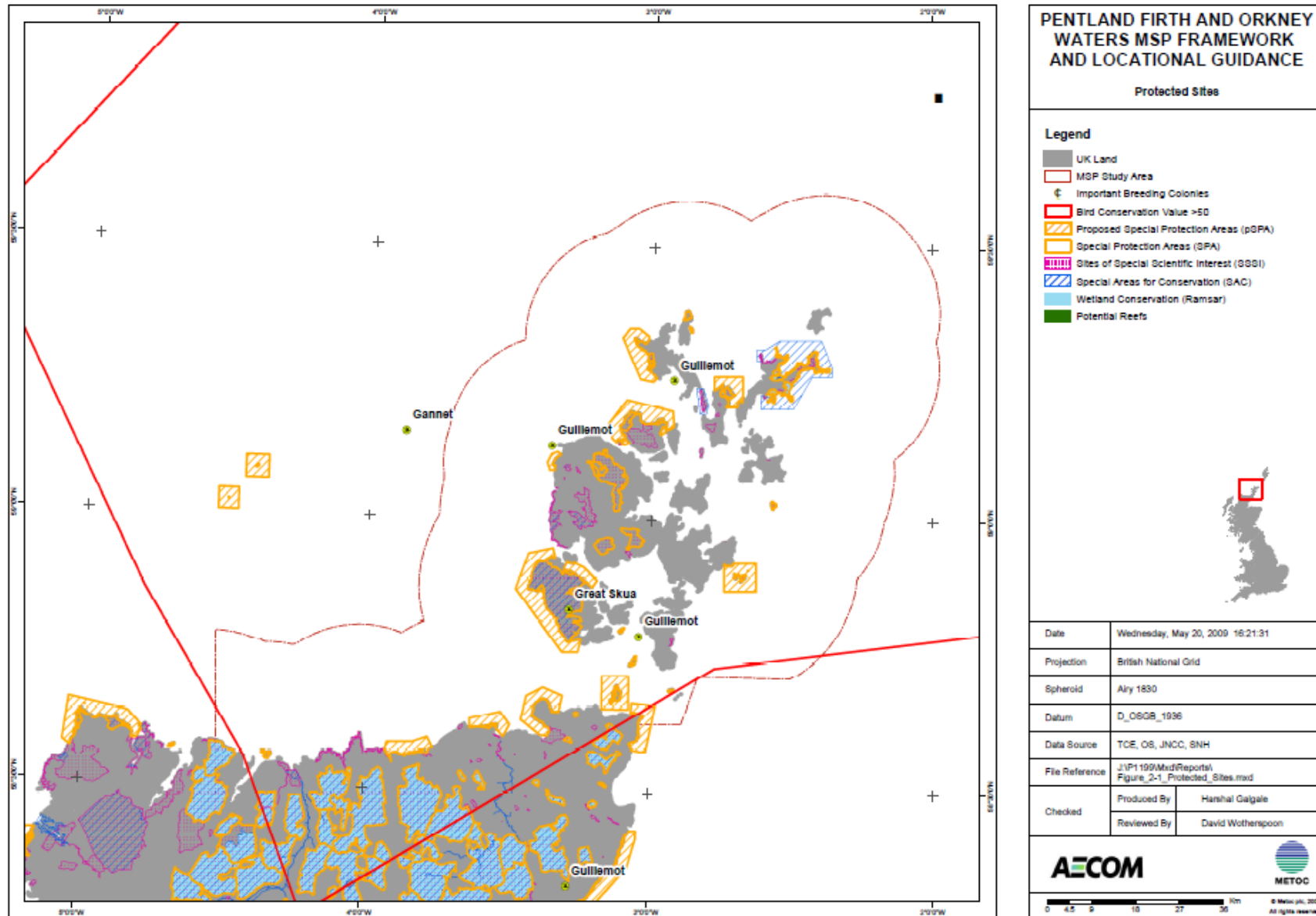
<http://www.snh.gov.uk/publications-data-and-research/environmental-data/map/>

and

<http://gateway.snh.gov.uk>

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Figure 3.1: Protected Sites



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Bathymetry, Geology and Geomorphology and Coastal Processes

Bathymetry

Water depths in the bays and channels around the Isles of Orkney are generally less than 25m (reference to Chart Datum), and rarely exceeds 40m depth in any location. In comparison, the Pentland Firth is significantly deeper, with depths in the main channel reaching between 60m to 80m. Water depths increase to more than 90m in the western part of the Firth, between Hoy and Dunnet Head. Water in the Inner Sound, located to the south of the Island of Stroma is shallower, with maximum water depths of around 35m.

Geology and Geomorphology

The varied and rich landscape and wildlife of North Caithness and Orkney reflects the underlying geology of the area. Both Caithness and Orkney are underlain by a sedimentary sequence of Devonian age rocks, sometimes referred to as the old red sandstone. This bedrock has been moulded by sea and ice which gives north Caithness and Orkney its characteristic flat to rolling lowland hill landscapes⁴.

The present day coastal geomorphology is related to variations in the hardness and composition of the bedrock. This is most evident within and around the Pentland Firth where the erosion of softer sedimentary deposits has resulted in the creation of the characteristic dramatic vertical cliffs along the north Caithness coast and similar cliff formations such as the Stacks of Duncansby. Similar features including the Old Man of Hoy are also present around the Orkney Isles.

One of the key characteristics of the geology of this area are the fossil-bearing fish beds that were created when the central parts of the vast inland freshwater lake known as Orcadia become anoxic³. The lake, which was thought to have existed for millions of years, formed part of a basin that was created during the deposition of the Devonian sandstone into the area from the highlands to the west and south. Although much of the basin is now submerged, evidence of the lake remains in the fish fossils that occur across the area.

Both Orkney and North Caithness also contain a number of nationally important examples of glacial and pre-glacial deposits and raised beaches. A number of these are designated as geological SSSIs and Geological Conservation Review Sites (GCR). These sites include Hoy and Muckle Head and Selwick on Orkney which are both excellent examples of raised beaches, and Invernaver, Red Point

and Dunnet Links SSSIs, which are all good examples of coastal geology and geomorphology.

Coastal Processes

Generally the north coast of Caithness is rocky and resistant to erosion and experiences minimal erosion or deposition of sediment. In comparison sediment movements and coastal processes around the Isles of Orkney are much more complex due to the number of islands, channels and indented bays. In addition the presence of the Churchill barriers adds complexity to the process of sediment transport.

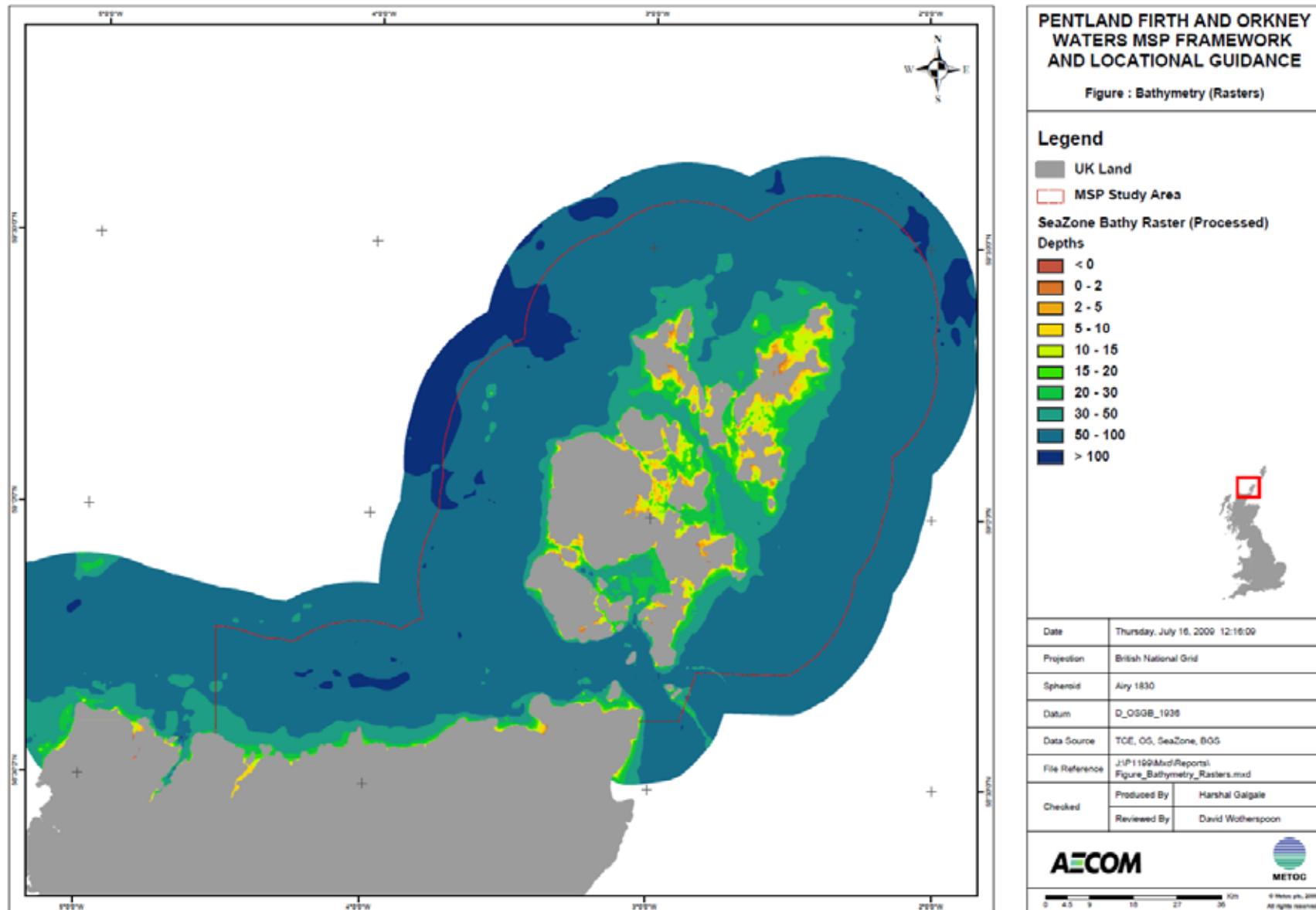
Coastal processes around the isles vary from south to north. In the south the isles are rocky and subject to harsh wave conditions. Consequently most beaches experience long term coastal and cliff erosion with a transfer of sediment from east to west. The central isles, including part of the mainland are subject to much lower levels of wave action and generally experience very little sediment transfer. To the north the intricacy of the indented bays and beaches and alignment of the individual islands limits the potential for beach to beach transfers, although there is evidence of some sediment movements resulting from wave action on more exposed part of the coast.

Baseline figures are provided below with further figures contained in Appendix A.

³ http://www.scottishgeology.com/geology/regional_geology/northern_isles.html

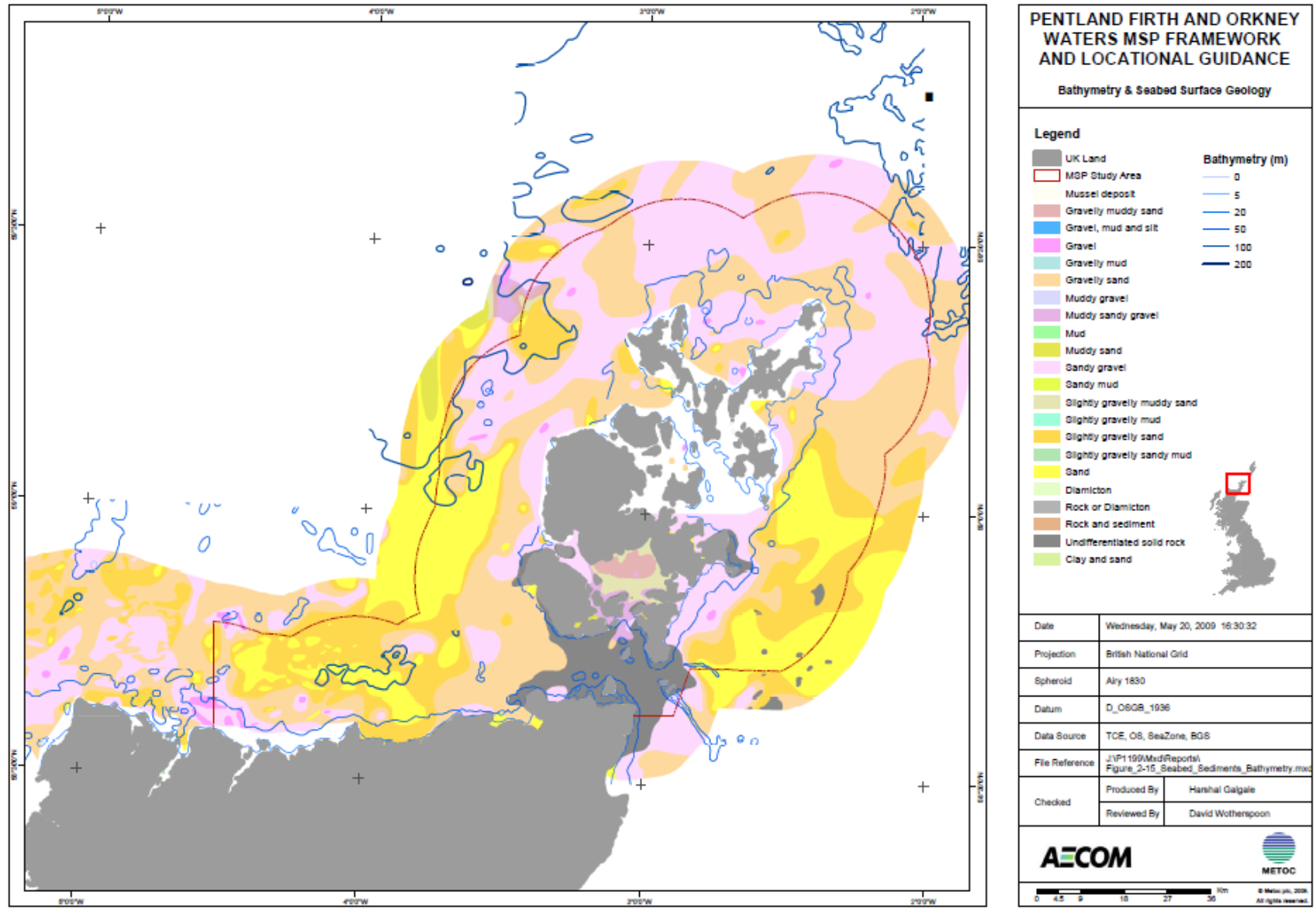
SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Figure 3.2: Bathymetry (Rasters)



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Figure 3.3: Bathymetry and Seabed Surface Geology



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Seascape and Landscape

The landscape of Orkney is typically characterised by open rolling lowland hills surrounded by dramatic coastal scenery. Land height is generally less than 200m and is as little as 30m at the lowest points. The exception is Hoy which ranges from 300 to 400m in height.

Much of the landscape comprises fields of improved pastoral grassland with some areas of arable agriculture. Areas of higher ground are characterised by heather moorland. Field boundaries comprise a mixture of post and rail fencing with some areas where dry stone walls are still prominent. The landscape has a lack of tree and woodland cover, adding to its generally windswept character.

The interface between the landscape and seascape is a key feature of the Orkney landscape character. The western seaboard is characterised by dramatic 300m sea cliffs and associated arches, stacks, geos and ghoups. The lower lying coastal areas are dominated by titled flags, dune systems and sandy bays. The numerous shallow inland and sea lochs and indented bays of the mainland give the lower lying areas a flooded feel.

The rich archaeology and build heritage of the island adds to the distinctiveness of the landscape and is clearly evidence across the Orkney Isles. Visible prehistoric remains such as cairns and brochs are important features of the coast.

The seascape character of Orkney varies from the wild, rugged and exposed seascape associated with the high cliffs of the west coast to low coastal sands and flats in surrounding coastal areas. Views out to open sea from the west coast tend to be expansive and uninterrupted with a feeling of exposure and wildness which is heightened by the remoteness of some areas. Elsewhere, views out to sea from the lower lying areas vary from open and uninterrupted to intimate and small scale within more sheltered bays or indented inlets. These views and the surrounding seascape create a feeling of tranquillity.

The landscape and seascape of the north Caithness and Sutherland is distinctly different. The landscape of Caithness and Sutherland comprises a vast expanse of open peatland forming one of the largest areas of blanket bog in Europe. These areas of peatland are interspersed with a number of uniform coniferous plantations and the occasional mountain or hill, each with distinctive profiles enhanced by the flat openness of the surrounding peatland.

The coast along the north coast of Caithness and Sutherland is dominated by high towering vertical cliffs that drop into surrounding rough seas and raised platforms. The cliffs are interspersed at regular intervals by sheltered sandy bays which tend to form a focus for human activity comprising harbours, crofting agricultural and residential areas and associated facilities.

The landscape of Sutherland and Caithness, and its scattered abandoned and ruined settlements, illustrates a legacy of agricultural decline in the area which followed the collapse of extensive Cheviot sheep farming and associated 'Sutherland Clearances' and 'crofters war' of the 1880's. Agriculture continued to decline throughout the 1900s following booms in more coastal activities such as herring fishing⁴ and the subsequent growth of the services industry and introduction of capital infrastructure schemes such as hydropower, plantations and construction and operation of the Dounreay nuclear power site.

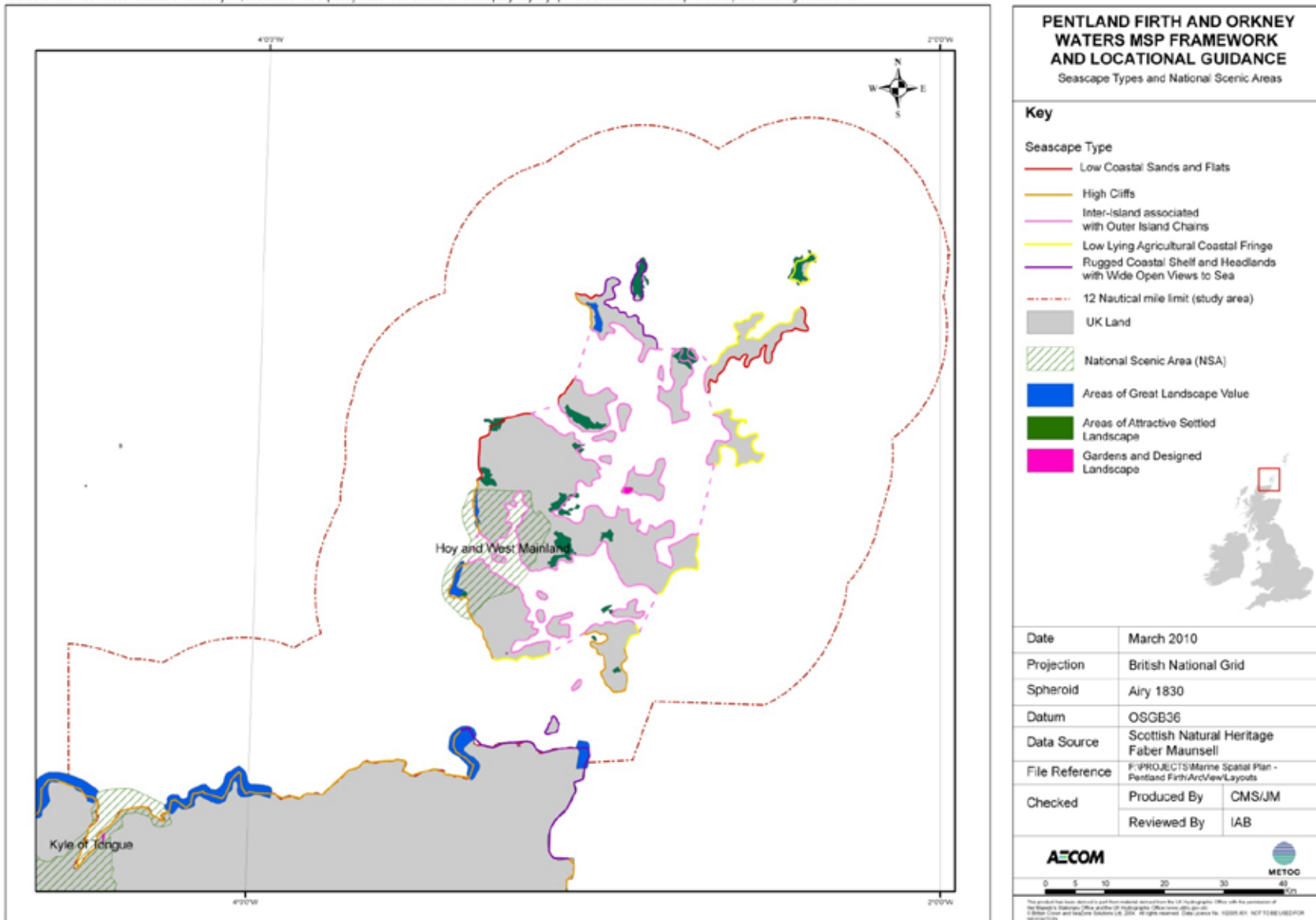
At the coast, the seascape is dominated by high cliffs and the rugged coastal shelf and headlands. There is a sense of exposure, wildness and remoteness along large stretches of the north coast, particularly where surrounding hinterlands are now uninhabited. Views out to sea tend to be open and uninterrupted, with the feeling of exposure and wildness often heightened by the roughness of the sea and general inaccessibility of the area.

A baseline figure showing designated sites and landscape character types is provided below.

⁴ Stanton, C. 1998 . Caithness and Sutherland landscape character assessment. Scottish Natural Heritage Review No 103.

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Figure 3.4: Seascape Types and National Scenic Areas



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Archaeology and Heritage

Both Orkney and Caithness and Sutherland have a rich archeologically heritage. In Orkney there are more than 300 Scheduled Monuments and a large number of other important archaeological and historical features and sites. One of the most important areas is the Heart of Neolithic Orkney World Heritage Site designated by UNESCO in 1999. This includes the large chambered tomb of Maes Howe, Skara Brae, the ceremonial stone circles of the Stones of Stenness and the Ring of Brodgar and a number of unexcavated sites that depict life on the island 5000 years ago. There are also numerous brochs, standing stones, chambered cairns and tumuli outside the World Heritage Site, a large number of which are found on the west coast and are at increasing threat from coastal erosion.

In addition to the wealth of Neolithic remains there are also a number of religious and secular sites from the 12th Century including St Magnus Cathedral in Kirkwall which is 500 years old, longhouses and other remains from Viking times and evidence of the Norwegian reign which lasted until 1468. More recent features of historic importance include the Churchill Barriers, constructed during World War II as protection for the British Navy within Scapa Flow. These now provide vital road links from the Mainland to South Ronaldsay.

Further offshore, given the richness of the archaeological remains onshore, it is likely that there is further evidence of submerged remains. Some of these may date back to the late Palaeolithic (>12,000 years BP) and early Mesolithic (>5,000 years BP) periods when, following early retreat of ice from the northern islands, there was the existence of land links or short crossings between exposed land. These land links and short crossing now form part of the present day seabed, within which it is likely that important sites and features may still remain.

There are also a number of wreck sites in the waters around Orkney and within the Pentland Firth. These include for example the remains of the Royal Oak and scuttled German Fleet in Scapa Flow.

There is also a wealth of archaeological remains on the North Coast (Caithness and Sutherland) including prehistoric coastal remains of brochs, standing stones, stone rows, tumuli and chambered cairns. There are over 1200 sites of historic importance in Caithness and Sutherland including 564 Scheduled Monuments, 649 Listed Buildings and 6 Gardens and Designated Landscapes.

It is also estimated that there are many more undiscovered archaeological sites and features in this area. This rich archaeological and heritage potential is being

further investigated as part of the River of Stone Project (Caithness) and the Strathnaver Province Archaeological Project. The River of Stone Project, which is being undertaken by AOC Archaeology Group and the Caithness Archaeological Trust, aims to recognise the economic benefits of providing greater interpretation and presentation of the County's archaeological heritage⁵.

The Strathnaver Province Archaeological Project has been set up to investigate the archaeological remains from Viking, Norse and medieval settlement in the old province of Strathnaver which covered northern Sutherland from the border of Caithness on the east to Cape Wrath and Assynt on the west⁶.

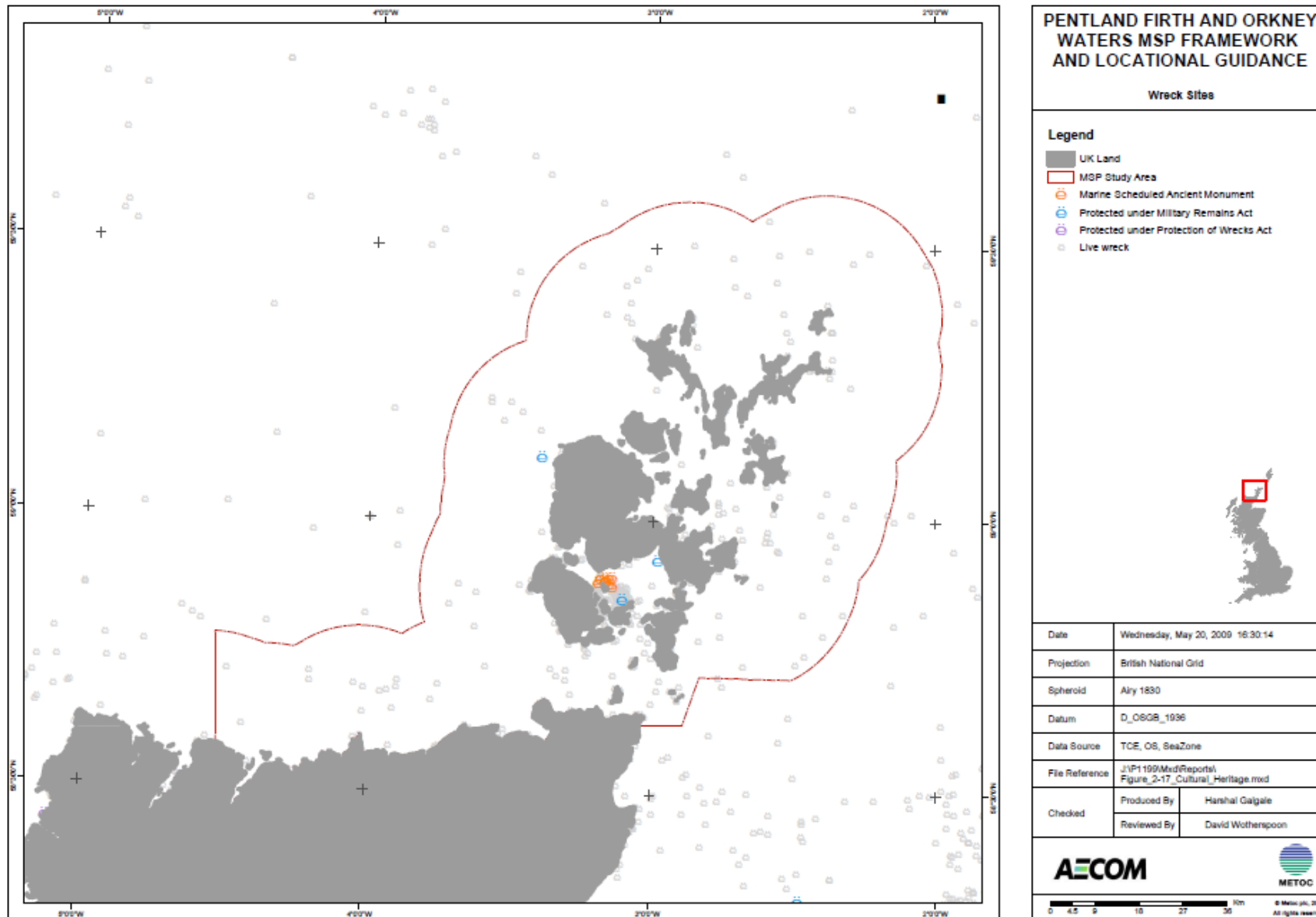
A baseline figure showing wreck sites is provided below with further figures showing other sites of heritage and archaeological interest provided in Appendix A.

⁵ <http://www.caithness.org/history/archaeology/>

⁶ <http://www.northsutherlandarchaeology.org.uk>

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Figure 3.5: Wreck Sites



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Water Quality

The quality of Scottish waters, in particular waters around the north coast and Orkney largely reflects the oceanographic regime (Orkney is positioned on the edge of the Atlantic Gulf Stream which assists in the dilution and dispersion of any contaminants or pollutants that enter coastal waters). The generally good water quality (e.g. 71% of water bodies in Orkney were classified under the Water Framework Directive as being of good or high ecological status (From the Scotland River Basin District Area Management Plan for Orkney and Shetland, SEPA 2008) also reflects the range of legislation and statutory controls that have been applied over the last decade including the application of full treatment to sewage discharges, improved treatment of industrial effluents, and work to reduce diffuse pollution.

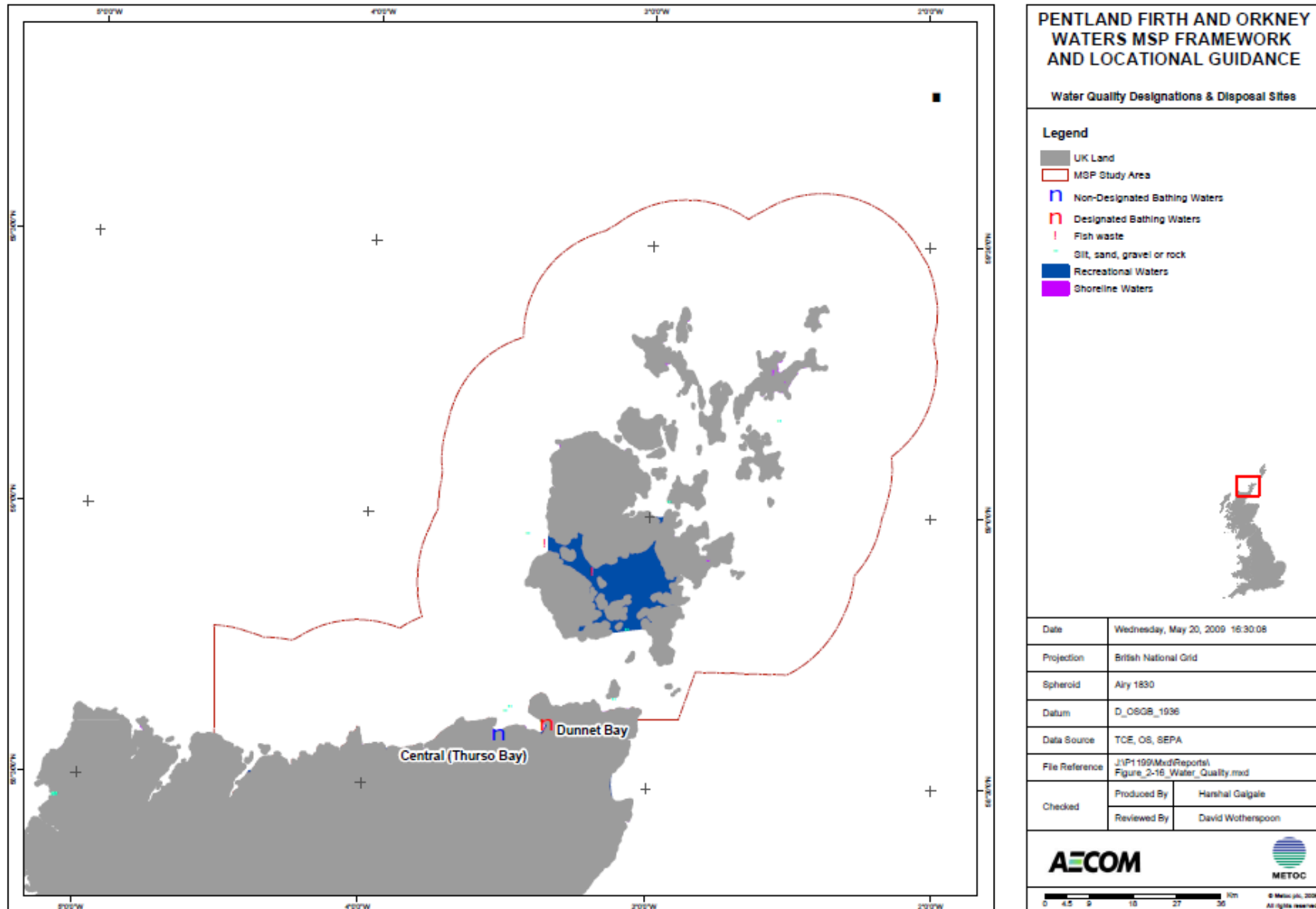
SEPA have now developed the River Basin Planning System with the Scotland RBMP, adopted in late 2009. Area specific RBMP's are under further development and the MSP will take cognisance of the RBMP in addressing potential water quality interactions and issues. Further information can be found at http://www.sepa.org.uk/water/river_basin_planning.aspx

Marine fish farming has expanded in extent and economic value, but has been managed and controlled to minimise its impact, although in more sheltered coastal locations there are still concerns over localised pollution from waste food, faeces and discharges of chemicals and antibiotics used to control disease. There is also some pollution from minor spills from oil tankers and tank washing at sea.

Coastal water quality is illustrated by the quality of designated bathing waters. There are two bathing water beaches in the area covered by this MSP Framework, Dunnet Bay and Thurso. Both of these are classed as having excellent water quality.

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Figure 3.6: Water Quality Designations and Disposal Sites



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Air Quality

Air quality in Orkney, Caithness and Sutherland is generally good. This is mainly due to low population densities (in particular in Caithness and Sutherland), low volumes of traffic and predominance of agricultural land practices. There are also limited industrial processes within the area.

Climate and Climate Change

The climate on Orkney and the North Coast of mainland Scotland is influenced by its position on the edge of the North Atlantic Current which delivers warmer water to the western seaboard of Scotland creating a relatively mild and wet climate with strong prevailing south westerly winds.

Additionally, Scotland's position between subpolar and subtropical influences, and its varied coastline of sheltered sea lochs, wave exposed rocky coasts, small and large estuaries and sweeping sandy beaches, means that Scottish waters support a rich and diverse range of marine species and habitats.

Although data and trends indicate that there are changes occurring in the climate on a global scale, the precise cause of climate change and likely effects of climate change at a global and local scale are still under debate. From the perspective of the marine and coastal environment it is thought that the most likely effects of climate change may include⁷:

- § Sea temperature increases
- § Air temperature increases (affecting air water interface)
- § Increased acidification of sea water
- § Increased or strengthened stratification of water
- § Sea level rise and 'coastal squeeze'

⁷ Hiscock, K., Baker, G., Crump, A. & Jefferson, R., 2005. Marine Life Topic Note. Climate change and marine life around Britain and Ireland. *Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme* [on-line]. Plymouth: Marine Biological Association of the United Kingdom. Available from: <<http://www.marlin.ac.uk>>

There is potential that increased sea and air temperatures, increased acidification of the sea and increased or strengthened stratification of water could significantly affect marine life. As discussed previously the rich and varied diversity of species and habitats in the waters around Scotland, including Orkney and the Pentland Firth is influenced by the presence of warm Mediterranean Atlantic species to the south west and cold boreo-arctic species to the north and east. There is potential that increases in sea temperatures could influence the distribution and abundance of certain species, with the possible northward extension in the range of 'warmer' water species with a reduction in the southward extent of the colder 'boreo-arctic' species⁷.

This will not only affect individual species but is also likely to affect other species and potentially entire ecosystems. The effects are expected to be most significant where changes in the distribution and abundance of specific planktons affect the availability of food for particular fish species. There is also concern that changes in fish populations could have wider knock on effects on species for which fish are an essential food source e.g. seabirds and marine mammals.

Increased sea temperatures could also lead to an increase in presence and range of invasive species, placing a further threat on vulnerable species and habitats. In addition to increased sea temperatures, increased acidification of the sea could also affect species and habitats distributions and abundance, in particular species with carbonate skeletons and structures⁷. The loss of these species could have significant effects on entire ecosystems.

Habitats and species are also likely to be affected by increased stratification which could reduce upwellings of nutrients in certain locations, reducing productivity and therefore the availability of food for organisms. Increased stratification could also lead to the de-oxygenation of deeper layers and the loss of seabed organisms⁷.

In addition to the effects on marine life, climate change also presents a significant threat to coastal populations due to sea level rise and storm surges. This is of particular concern in Orkney where there are a number of low lying areas that support local communities and are occupied by essential infrastructure. Sea level rise also leads to an increased risk of coastal erosion and coastal flooding which could threaten the integrity of a number of the key coastal and intertidal habitats, archaeological sites and features e.g. Skara Brae for which Orkney is well recognised

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

RENEWABLE ENERGY

The waters within the Pentland Firth and around the Isles of Orkney have been identified as having a significant potential resource of wave, and in particular, tidal energy. One of the key aims of this MSP Framework is to identify how the wave and tidal industry within the Pentland Firth and Orkney waters is expected to grow by 2020 and examine how this growth can be managed through the creation of a coordinated and cohesive planning framework to ensure:

- § Potential adverse effects on other marine sectors, including the environment, are managed appropriately.
- § Growth of the industry is sustainable.
- § Opportunities for wider benefits to other sector and local communities are maximised.

The key elements of renewable energy that are covered in this MSP Framework include:

- § Tidal Energy
- § Wave Energy
- § Offshore Wind Energy

The above are discussed in detail in the Regional Locational Guidance presented in Part 2 of this Report. A summary of key points is provided below.

Tidal Energy

The Pentland Firth and Orkney Waters lie near the boundary between the North Atlantic and North Sea tidal systems. The incoming North Atlantic tide reaches the Orkney Islands several hours before the North Sea tide causing a net flow of water from west to east on the flood tide, particularly through the Pentland Firth. This net flow of water creates the energetic and strong tidal stream for which the area is becoming known for in terms of marine renewable.

The tidal stream is strongest where water is forced through constrained channels e.g. between Pentland Firth and some of the channels between the Orkney Isles, and around headlands e.g. to the north of Papa Westray and North Ronaldsay.

Tidal streams around the Isles of Orkney are dictated by water depth and topography. The islands form a barrier to the flooding North Atlantic tidal wave as it rounds the north of Scotland to enter the North Sea, and forms a similar barrier to the ebbing tide travelling in the opposite direction. The effect is to force strong flows north and south of the Islands through various channels that dissect them. The areas of strongest flow are found in the following areas:

- § North of Papa Westray
- § North and northeast of North Ronaldsay
- § North Ronaldsay Firth between North Ronaldsay and Sanday
- § Lashy Sound (northern part of Eday Sound between Eday and Sanday)
- § Calf Sound between Eday and Calf of Eday
- § Westray Firth between Westray and Rousay
- § Stronsay Firth between Shapinsay and Stronsay
- § Eynhallow Sound between Mainland and Rousay
- § The String and Shapinsay Sound between Mainland and Shapinsay
- § Channels leading to Scapa Flow (Hoy Sound, Burra Sound and Sound of Hoxa)

Tidal currents in the Pentland Firth are very complex and highly variable, due to strong flows and the presence of reefs and islands, variable water depths and the influence of the weather. The main tidal streams areas include the Merry Men of Mey between Tor Ness on Hoy and St John's Point on the Scottish mainland, the channel between the island of Swona and the Orkney Island of South Walls (Hoy) and South Ronaldsay; the Outer Sound between Swona and Island of Stroma, and the Inner Sound between the Island of Stroma and the Scottish Mainland. There are also significant tidal races southwest of the island of Stroma and further east offshore of the Ness of Duncansby on the mainland (the Duncansby Race).

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Some of the strongest currents are found in the eastern part of the Pentland Firth between North Ronaldsay and Muckle Skerry and between the Pentland Skerries and Duncansby Head. In comparison the tidal flows along the north coast of the Scottish mainland are much less energetic.

Wave Energy

The wave climate in the area of interest is dominated by the passage of low pressure system from the west to the east across the north Atlantic. In general the highest waves approach the Orkney area from westerly directions; these are also the directions from which waves occur most frequently.

Wave conditions are most severe (i.e. the wave field contains the greatest energy) in the exposed coastal areas to the west of the Orkney Islands. East of the Orkney Islands, the wave climate is less severe due to sheltering from the dominant westerlies, even though these sites are correspondingly more open to waves from northeast, east and southeast in the North Sea. Along the north coast of Scotland, the mainland itself and the northern tip of the Hebrides will result in sheltering for wave directions south of west, which will reduce the energy available in the wave field.

In addition to wave conditions, the wave period (duration of wave) is also important in determining potential resource. In general periods of 6 seconds (s) are common to the west and north of the Orkney Islands, while shorter periods of 4s are more typical in the Pentland Firth and to the east of the Orkney Islands.

However, these modal periods do not indicate the contribution from long-period swell waves. The dominant direction for these is west (i.e. propagating from the North Atlantic), so they will have the greatest impact in those areas most exposed to the west, namely the northwest part of the Orkney Islands. Swell wave periods of 10-16s are typical, and significantly longer periods of up to 40s have been measured. Swell wave climates tend to exhibit more regular periods and directions, and a narrower range of wave heights, than locally-generated wind waves.

Water depth and seabed topography also both have important effects in modifying incoming waves. As waves pass from deep water into shallower coastal waters, they begin to interact with the seabed. This causes the waves to slow down and steepen, ultimately to the point where their increasing steepness becomes unstable and wave breaking occurs. The effect of seabed interaction also causes waves to lose energy, thus reducing the amount of energy potentially available for wave power devices. These processes explain why wave heights, and the associated wave energy, tend to be lower in shallower, near-coast areas. Average wave heights in the Pentland Firth are lower than those northwest of the Orkney Islands due to the combined effects of sheltering and shallow water depths.

Wave orbital motions are the oscillatory currents associated with the passage of waves. These cause forwards and backwards movement associated with the passage of crest and trough respectively. Waves typically do not cause a net transport of water but can cause strong instantaneous loads on submerged structures. Wave orbital motions are aligned in the direction of wave propagation. The strength of these currents is primarily dependent on the height and length of the wave and the depth of the water. Typically, higher and longer waves will induce orbital motions at greater depths within the water column. The strength of the motion for a given wave diminishes with depth.

Offshore Wind

The future potential for offshore wind development is identified in Orkney Island Council's Local Development Plan Key Issues Report, but no specific offshore wind sites have been identified in this area either as part of Marine Scotland's Offshore Wind Plan or in the Crown Estate Leasing Round for Offshore Wind in Scottish territorial waters. This does not imply that opportunities for offshore wind developments within this area, in particular the waters off the east coast of Orkney, will not be identified in the future.

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

SHIPPING AND NAVIGATION

In terms of shipping and navigation the following area are covered in this MSP Framework:

- § Shipping and navigation
- § Ferries

The above are discussed in detail in the Regional Locational Guidance presented in Part 2 of this Report. A summary of key points is provided below.

Shipping and Navigation

Although the Pentland Firth is considered to be one of the most dangerous and unpredictable stretches of water in the UK due to it being prone to very strong tides, heavy seas and very poor weather conditions, it is recognised as a route of international importance for navigation and is therefore considered to be critical for shipping and navigation.

The area is used extensively by commercial cargo vessels as the main route from the North Atlantic to the North Sea. It is also used by oil tankers entering and exiting the main oil terminals at Flotta at the southern end of Scapa Flow. This combination of cargo traffic and oil tankers leads to very high numbers of vessel movements occurring within the main central channel. Very high densities of shipping also occur within the Orkney waters, in particular within the Scapa Flow area, the Stronsay Firth and around Kirkwall Harbour.

The Pentland Firth and waters around Orkney are also regularly used by local fishing fleets that are either passing through the area to access key commercial fishing grounds or land at local harbours e.g. Scrabster, Stromness or Kirkwall.

There is an area within Orkney waters which is to be avoided by vessels that are over 5000 gross registered tonnes carrying oil or other hazardous cargos to avoid the risk of pollution in that area.

Ferries

Both the Pentland Firth and waters around Orkney are used heavily by passenger ferries. These ferries provide essential links from the UK mainland to Orkney and are critical to sustainability of some of the smaller island communities which depend on the ferries to provide access to employment and essential services (e.g. food, healthcare, education). In total there are 13 inter-island ferries servicing the more remote islands to the north and south of Orkney. These carry around 320,000 passengers annually.

PORTS AND HARBOURS AND OTHER INFRASTRUCTURE

In terms of ports and harbours and other infrastructure the following areas are covered in this MSP Framework:

- § Ports and Harbours
- § Other Infrastructure e.g. coastal defences

Ports and Harbours

In total there are 17 harbours along the north Caithness Coast. Scrabster is the main harbour and is still an active fishing port and is the main port for sea angling. Scrabster has recently under-gone a number of improvements and has plans for further extensions to support the growth of the renewable energy industry.

There are 29 piers and harbours and slipways in Orkney. The main ports are Hatston Pier, Kirkwall Pier and Stromness⁸. The ports receive a variety of ships including cruise ships with up to 3500 passengers, oil tankers, cargo and freight vessels and other ships.

Crude oil is imported to the Flotta Oil terminal on the north coast of Flotta, through a 30 inch pipeline from several offshore facilities. Transhipment by tankers also takes place.

Scapa Flow itself provides a large sheltered anchorage and a number of ship to ship transfers take place within it.

⁸ http://www.orkneyharbours.com/ports_and_harbours.asp

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

The Orkney Council Local Development Plan Key Issues Report acknowledged that further studies are being undertaken to explore the options for Lyness on the western side of Scapa Flow to be developed for marine renewable energy.

The main port based activities that are likely to be associated with the wave and tidal industry are likely to include:

- § Docking of vessels (including jack up barges etc) used in the construction and maintenance of marine renewable energy developments.
- § Port side construction of devices/or parts of devices prior to deployment.
- § Loading and unloading of devices/parts of devices on/off vessels.
- § Docking of support vessels (e.g. safety) and other vessels e.g. boats used for environmental surveys before and during installation.
- § Docking for vessels used during operation for maintenance, in-situ servicing and environmental surveying/monitoring.
- § Maintenance and servicing of devices or device parts during operation.
- § Decommissioning activities.
- § Land side manufacture, servicing and maintenance activities

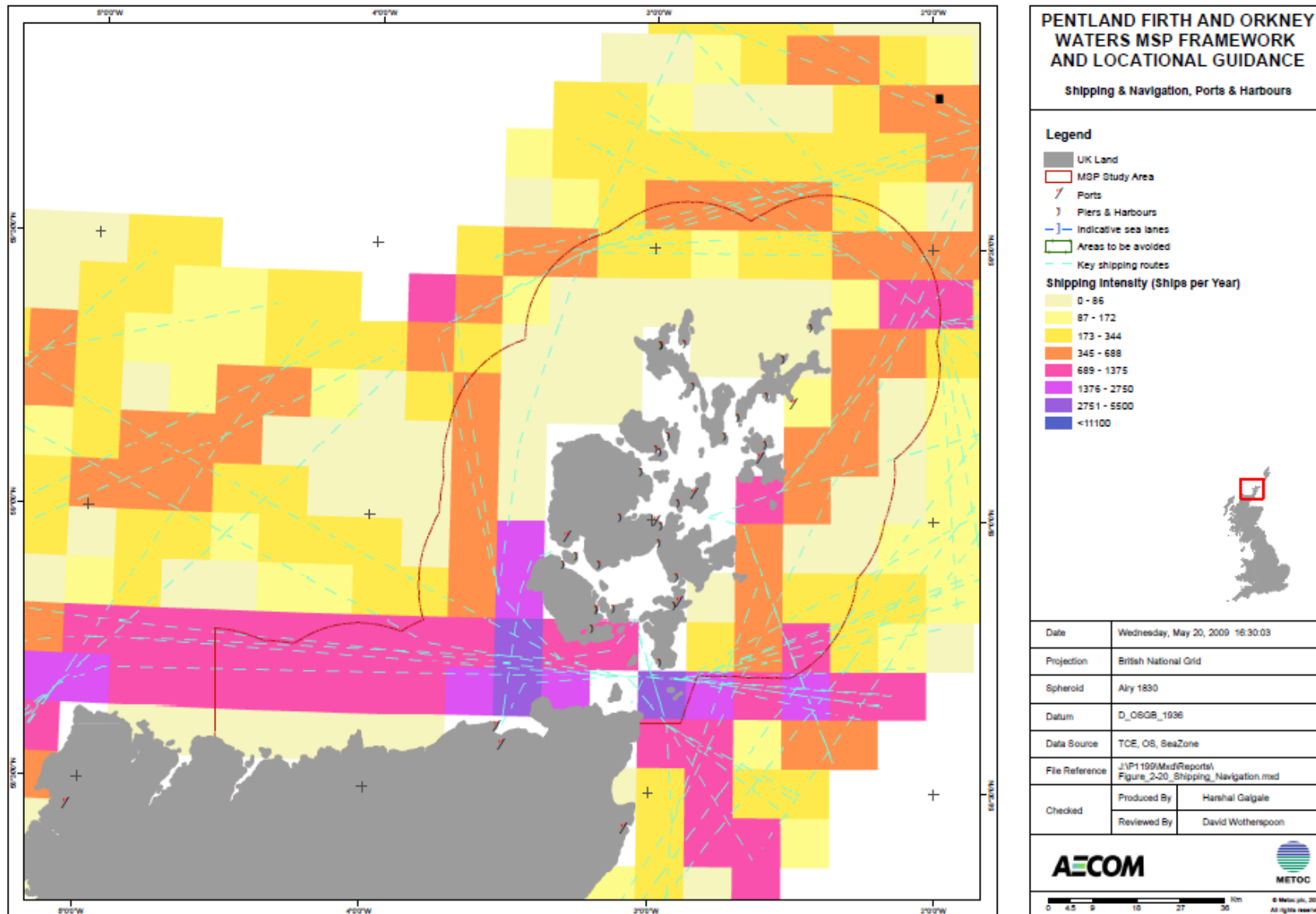
It has been identified that, in order to provide the necessary support to the marine renewable energy industry, the main ports and harbours within Orkney and on the North Coast of Caithness (e.g. Scrabster) may require significant investment and development to increase their capacity and enable them to provide the necessary infrastructure to support the main activities listed above.

Ports and harbours involved in the deployment and ongoing maintenance and servicing of devices may require 24 hour access for 365 days of year. There will also need to be sufficiently large lay down space and construction areas to accommodate large devices, as well as berths of sufficient capacity to accommodate large vessels and good road access.

However, it will be essential that the ports and harbours are able to continue providing their current services e.g. ferries and fishing and are able to expand as necessary and appropriate to accommodate other sectors e.g. cruise ships.

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Figure 3.7: Shipping and Navigation, Ports and Harbours



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Other Infrastructure

Infrastructure to Support Offshore Renewable Energy

It is not the responsibility of the MSP Framework, or any future statutory MSP, to make provision for or develop policy on land based infrastructure as this is the role of the land use planning system. However, it is recognised that, to support and promote the growth of the marine tourism and marine renewable energy sectors, there will be requirements for the provision of essential infrastructure such as land suitable for the manufacturing and servicing of renewable energy devices, roads, housing for additional employees.

Although planning for the provision of this infrastructure will be the responsibility of the local authority, it will be essential to establish a coordinated and joined up approach to the preparation of both the MSP and the relevant land use plans to ensure that infrastructure requirements to support the growth of the marine renewable energy industry and other marine sectors are identified and planned for at the earliest opportunity. These requirements have already been acknowledged in both the Highlands Council and Orkney Council Key Issues Reports.

However, it should be noted that with respect to the growth of the offshore renewable energy industry, in particular wave and tidal, it is likely that it will be a number of years before large numbers of commercial scale developments (e.g. 200MW or bigger) are being deployed in the Pentland Firth and Orkney waters. This potential timescales also need factoring into both the MSP and future land use plans.

Coastal Defences

There is concern that increased storminess and storm surges associated with climate change, and possible sea level rise, could place increased pressure on coastal areas, in particular on Orkney which is lower lying and more susceptible to coastal erosion than the hard cliffs of Caithness and Sutherland. Of particular concern are the potential effects of coastal erosion on Skara Brae and other key archaeological and heritage sites located along the west coast of Orkney. Further work is required to identify appropriate coastal defence solutions in these sensitive locations.

Grid Capacity and Reinforcements

It is acknowledged that, in general grid capacity to the north of Scotland and within the Orkney Isles is fairly poor and is potentially a limiting factor to the development of offshore renewable energy in this location.

On the mainland, the north coast is served by a single 275kV transmission line to Dounreay and a double circuit 132kV line to Thurso and on to Dounreay. Both lines originate from Beaulieu near Inverness. From Thurso electricity is distributed locally along the north coast via an 11kV and a 33kV network. There is no transmission system to north east Caithness, Sutherland or Orkney⁹.

In Orkney the grid is effectively built up of a 33kV ring system around the northern Isles and two 33kV ring systems around the southern isles. There is also some 11kV network. The 33kV network is fed from the 33kV Thurso interconnection⁹.

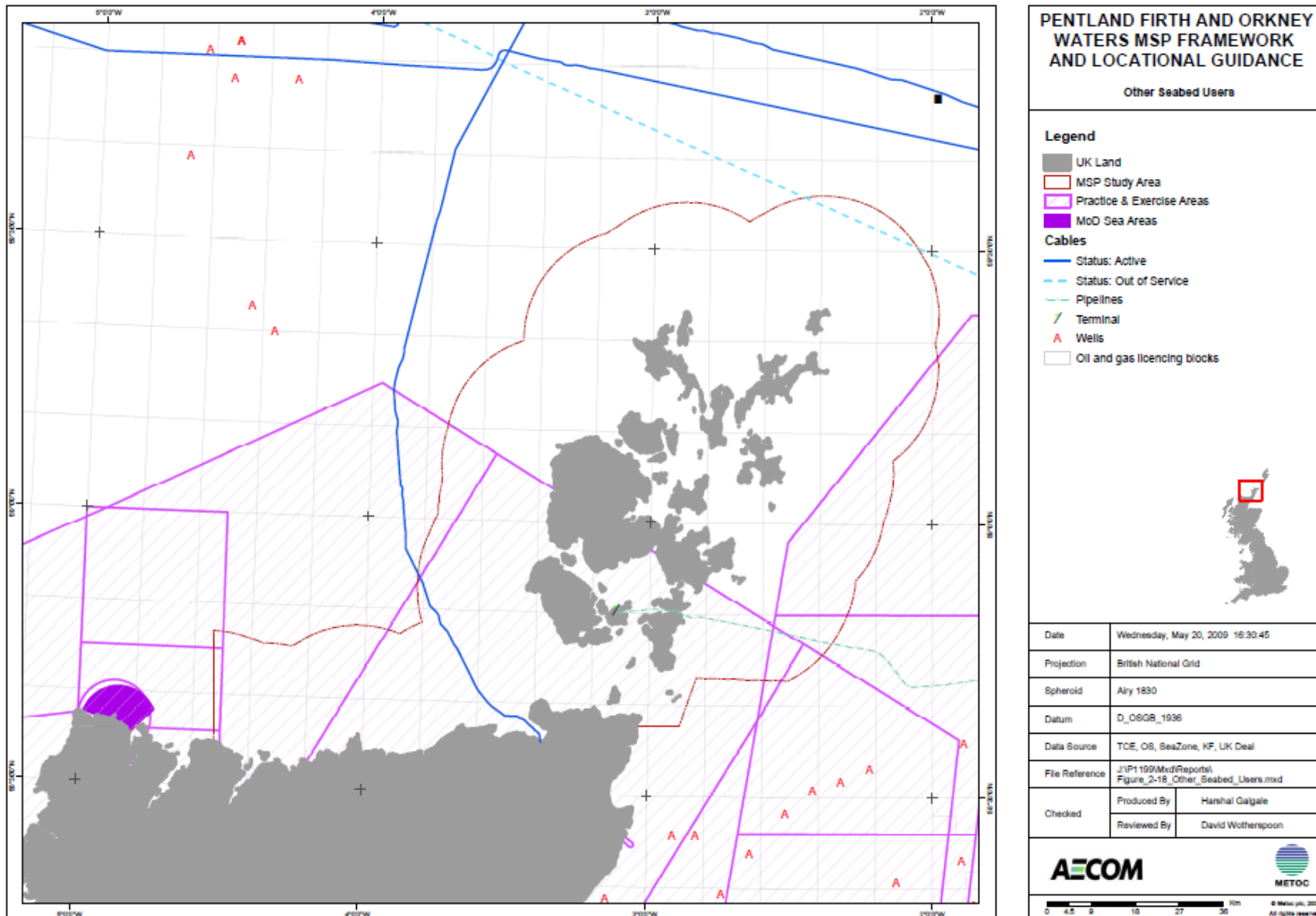
The Zero Energy report identifies that the Orkney system is effectively full in terms of capacity for any additional generation from wave or tidal schemes. Overall, even with upgrades, the existing distribution grid on this part of the UK mainland and in Orkney cannot accept more than 26MW. This is mainly due to local limitations on voltage and thermal issues on lines and at substations⁹.

Therefore, further extension of the capacity on the north coast and in Orkney will require new lines and substations. This requirement for new substations has already been identified in the Orkney Island Council Local Development Plan Key Issues Report (September 2009). The Zero Energy Report identifies that generation of 1,000MW by 2020 could be achieved with new grid infrastructure on the UK mainland only. For 1,700MW it is likely to be necessary to take 132kV grid infrastructure to Orkney. Overall, it appears that it will be difficult to develop the wave and tidal resource to the east of the area without major new lines across the region. However, a possible future DC link to the north east mainland coast from the Moray coast could offer a potential solution⁹.

⁹ Pentland Firth Tidal Energy Project Grid Options Study. Prepared for Highlands and Islands Enterprise. Zero Energy. January 2009. Reference: Rep 1072/001/002C.

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Figure 3.8: Other Seabed Users



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COMMERCIAL FISHERIES AND MARICULTURE

Commercial fishing is an important industry in the Scotland, both in coastal areas and further offshore towards the 12nm limit.

Key fisheries in the area include those for herring, haddock, cod, whiting, saithe and monkfish. These are a mixture of purse seine fleets and trawl gear, used as part of a mixed fishery. Whilst commercial fisheries do operate within the study area, the bulk of the catch is taken outside of the Pentland Firth and Orkney Waters study area: concentrated to the north-east of Orkney, around Shetland, the west coast of Scotland and along the continental shelf area.

Other fishing activities occurring within the waters around Orkney and Pentland Firth include:

- § Lobster and brown and velvet crab pot fishing – this occurs along the Caithness and Sutherland Coast and all around the Orkney Isles.
- § Whelk and scallop dredging and diving - this occurs mainly along the east coast of Orkney and within the Stronsay Firth, Scapa Flow and the North Sound.

Landings statistics from Scottish Government (2009) show that in 2007, a total of 3,200 tonnes with a value of £5.7 million were landed into Orkney by UK vessels. Wick, which is just south of the study area, was shown to have landings of 12,200 live weight tonnes which valued £18.7 million.

Mariculture, in the form of finfish and shellfish farming is also important in coastal areas within the study area. There are two general types of Mariculture practiced in Scotland which involve:

- § Finfish in cages, or land-based tanks with pumped seawater
- § Shellfish either on trestles on the seabed, attached to vertical 'dropper' ropes suspended from horizontal longlines or rafts, or grown directly on the seabed without equipment.

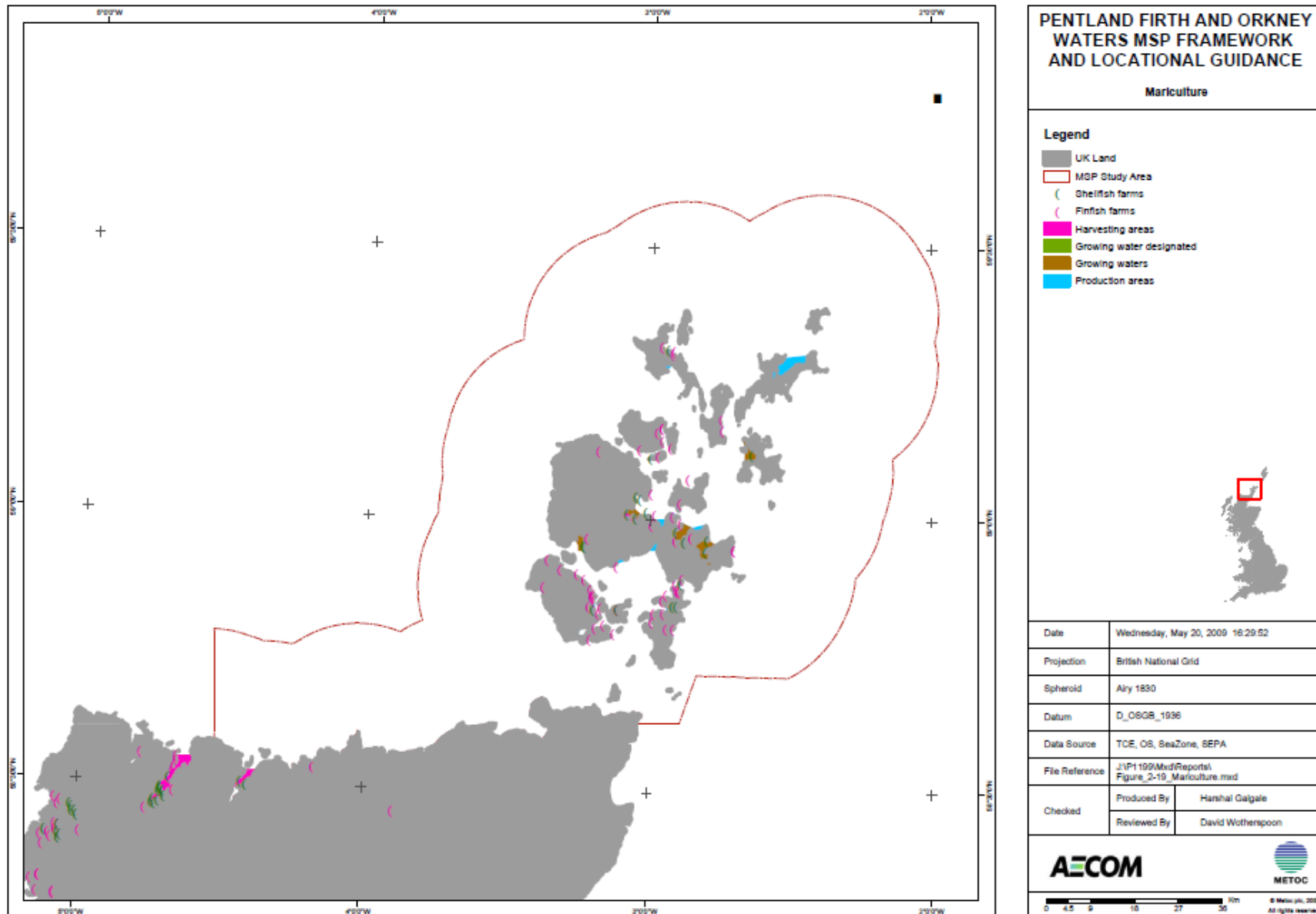
Within the study area, finfish and shellfish farms can be found in a number of locations around the coast of Orkney (See RLG sections). There has been a longstanding policy presumption against finfish farm development on the east and north coasts of Orkney to safeguard migratory fish species. Aside from Loch Eriboll, no finfish or shellfish farms are sited in these areas.

Orkney Islands Council controls planning issues associated with the planning, licensing development controls for mariculture in their area of responsibility.

Further information on commercial fisheries is provided in the Regional Locational Guidance presented in Part 2 of this Report.

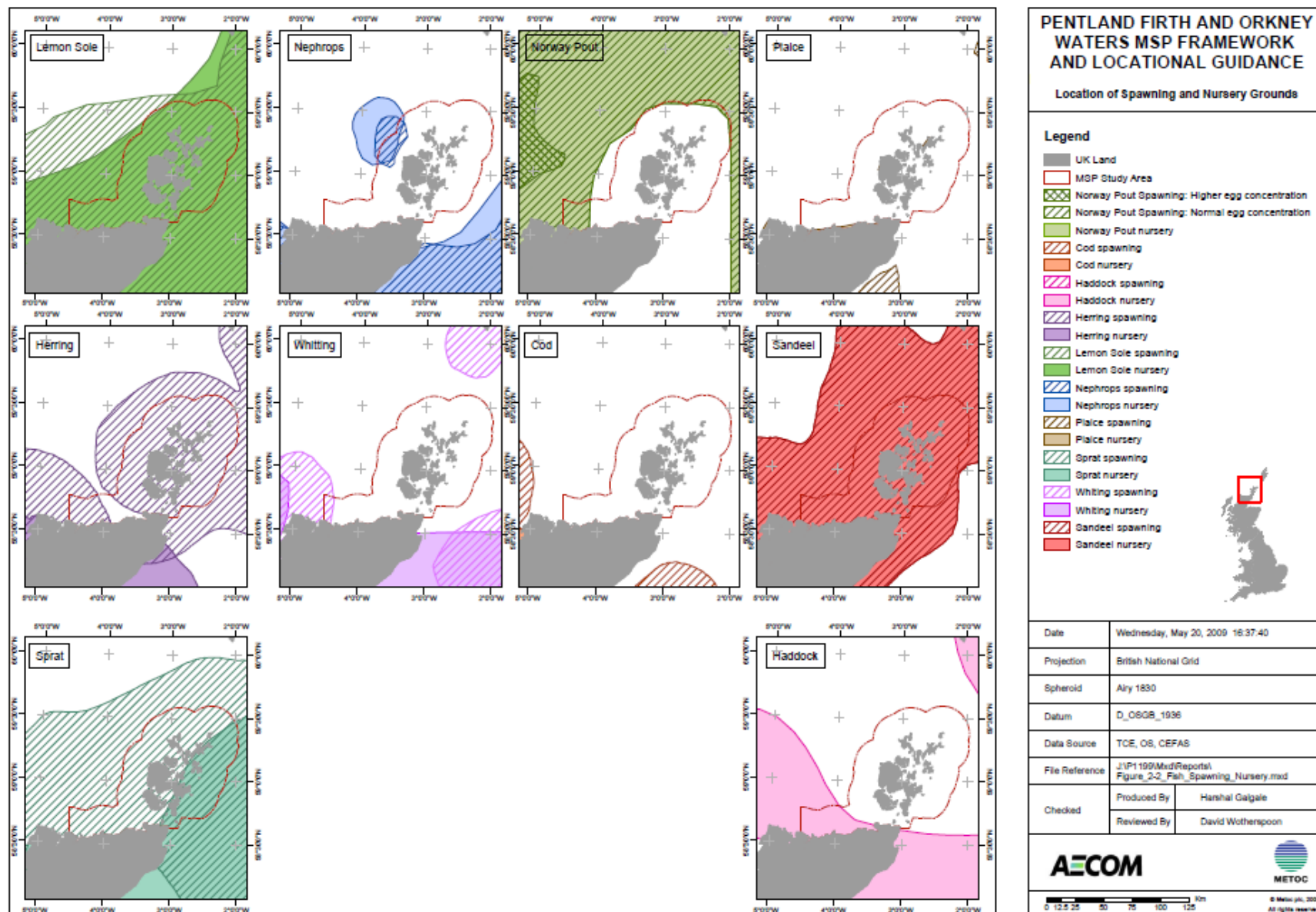
SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Figure 3.9: Mariculture



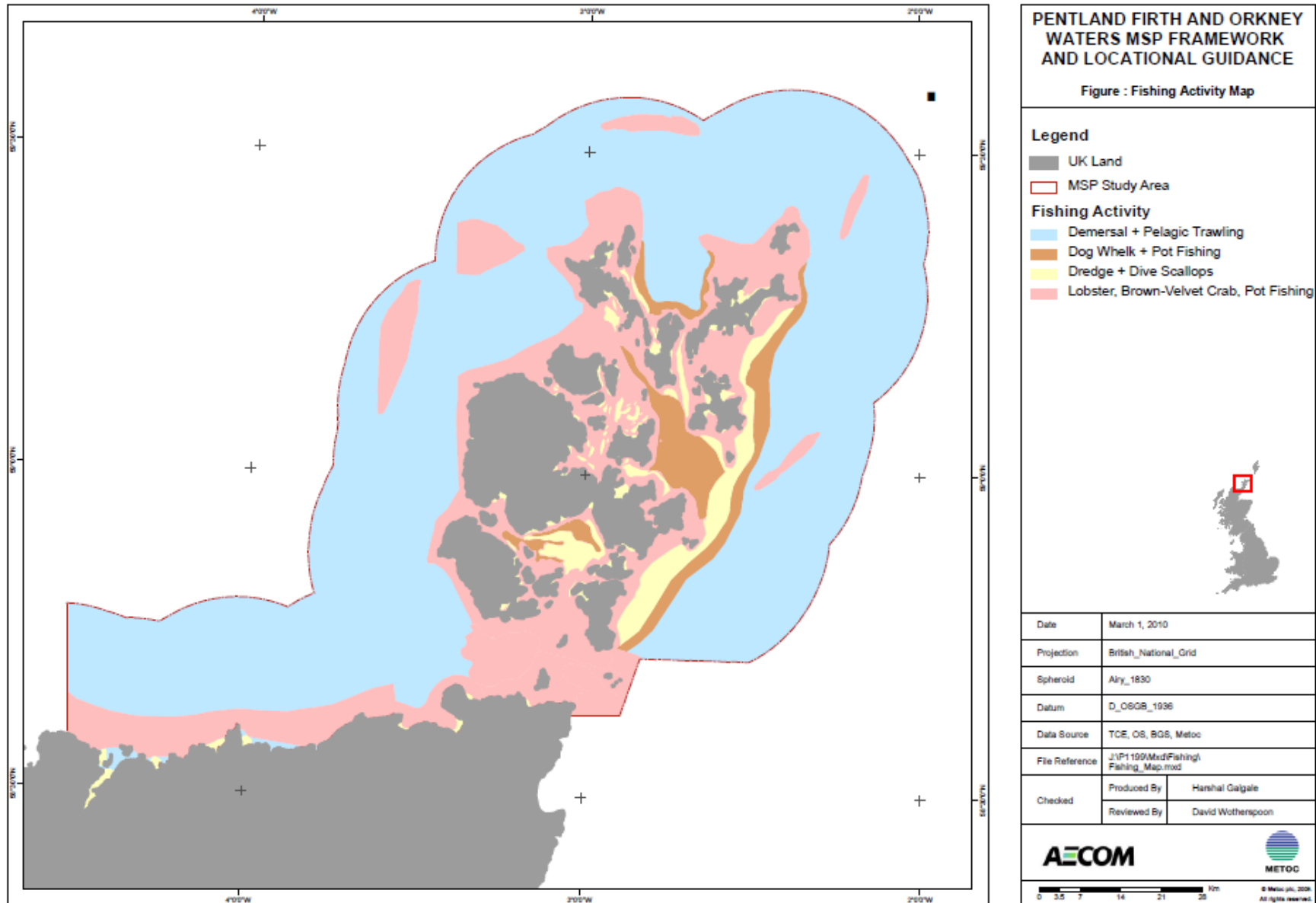
SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Figure 3.10: Location of Spawning and Nursery Grounds



SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Figure 3.11: Fishing Activity Map



SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

TOURISM AND RECREATION

The waters around Orkney are very popular for recreational sailing, with yachts from the west and east coast of Scotland and from further field such as Norway attracted by the scenic and dramatic coastline and numerous sheltered bays and deserted beaches. There are three main marinas on Orkney: Kirkwall, Stromness and Westray, and a number of mooring spots around all of the Islands. In 2008 549 visiting yachts (55% from the UK, the rest from Norway, Germany, Holland, Sweden, Denmark, USA, Australia, and New Zealand) booked a berth in these marinas. There are also a considerable number of local boats which do not have a marina berth.

Recreational sailing off the north Caithness coast is limited by the harsher sailing conditions within the Pentland Firth.

In addition to recreational sailing other recreation and tourism activities in both Orkney and the coastal and marine areas off the north coast of Caithness and Sutherland include coastal walking, kayaking, surfing, diving, sea angling and rock climbing. Scapa Flow, Orkney, is been recognised as a key location for diving with the opportunity to view the scuttled German Fleets from World War I as well as a number of other ship wrecks in the area. The waters around Orkney and off the north coast of Caithness and Sutherland are also recognised locations for viewing a range of natural features and marine wildlife.

There are a number of locations along the west coast of Orkney and the north Caithness and Sutherland coasts recognised locally for surfing due to the wave regime in the area, including but not limited to, the Bay of Skail, Marwick Bay, Outshore Point and Costa Head. In terms of sea kayaking, the waters around Orkney and the Pentland Firth offer different experiences from the calm, clear blue, sheltered waters off the east coast of Orkney to the more challenging fast flowing tidal races of the Pentland Firth and the rough western seaboard.

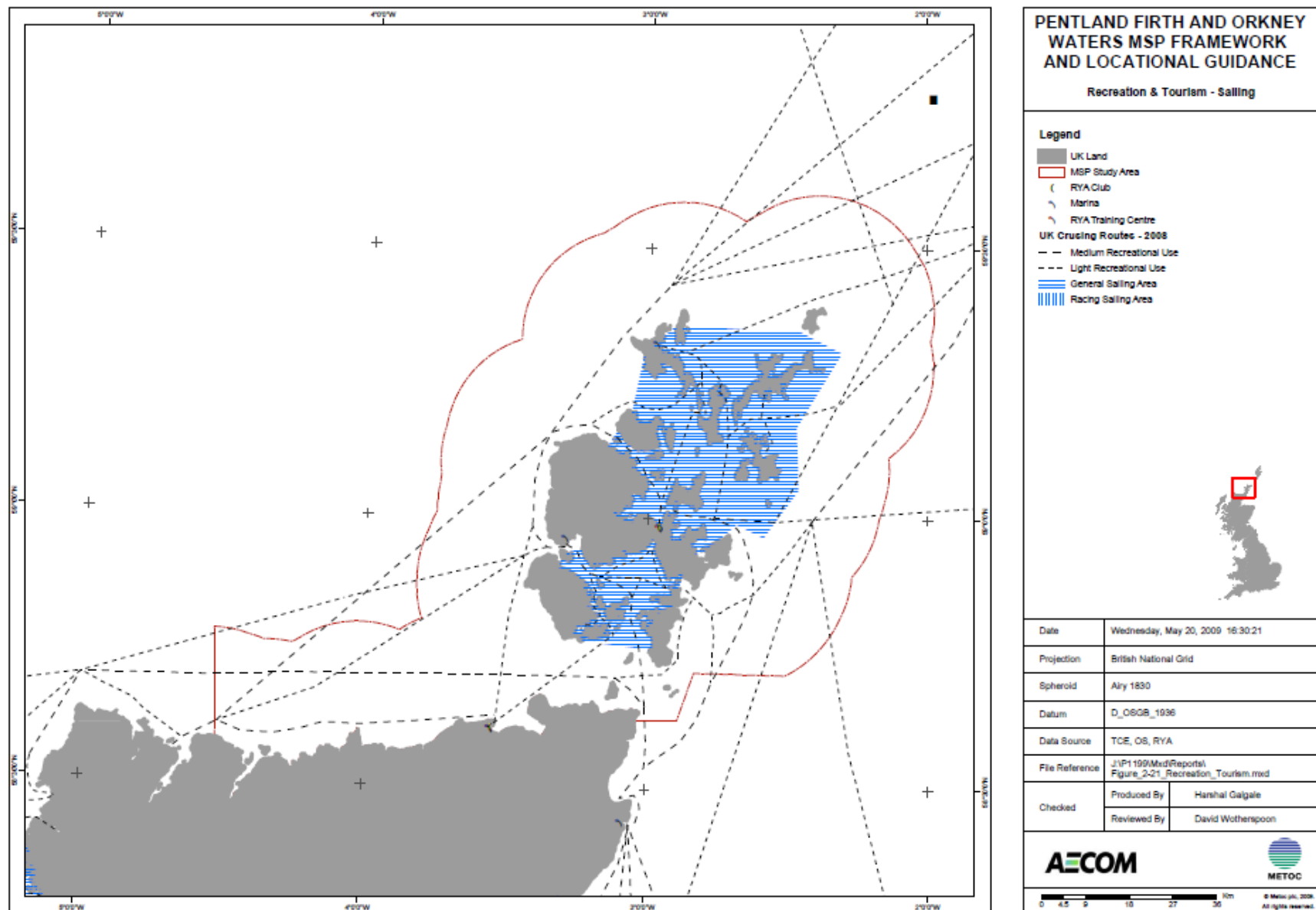
Key areas for rock climbing include the cliffs and associated stacks that are found along the north coast of the mainland and off the west coast of Orkney, with the most popular location being the Old Man of Hoy, a challenge to even the most experienced rock climbers. The rock climbing experiences along the north coast and around Orkney are heightened by the presence of extensive seabird colonies and the opportunity to view puffins.

Additionally the coastal areas of both Orkney and the north coast are recognised for their high scenic value and experience of remoteness and wildness. They are

also important in terms of archaeology, with the coastal site of the Skara Brae being one of the main tourist attractions in Orkney.

SECTION 3: THE PENTLAND FIRTH AND ORKNEY WATERS

Figure 3.12: Recreation and Tourism – Sailing



SECTION 4: STRATEGIC ISSUES AND INTERACTIONS

IDENTIFYING STRATEGIC ISSUES AND INTERACTIONS

One of the aims of this MSP Framework is to examine how individual marine sectors currently operate within the marine and coastal environment, how they interact with other marine sectors, and how these interactions are likely to change in the future as the different sectors expand or decrease.

In order to understand how the different sectors may change in the future it is necessary to identify what the longer term vision is for each of those sectors and what the sector requires to achieve that vision. It is also necessary to identify the likely conflicts or interactions with other sectors that may need to be resolved or addressed in order for growth or change to be achieved.

Once the key priorities for change or growth are identified, solutions or actions for managing change or growth in relation to other marine sectors and the protection and management of the marine environment will need to be explored. Possible options for delivering key actions and solutions are presented in Section 5 of this Framework document. These actions and solutions will ultimately be delivered through the preparation of a statutory marine plan and the development appropriate policies for individual sectors.

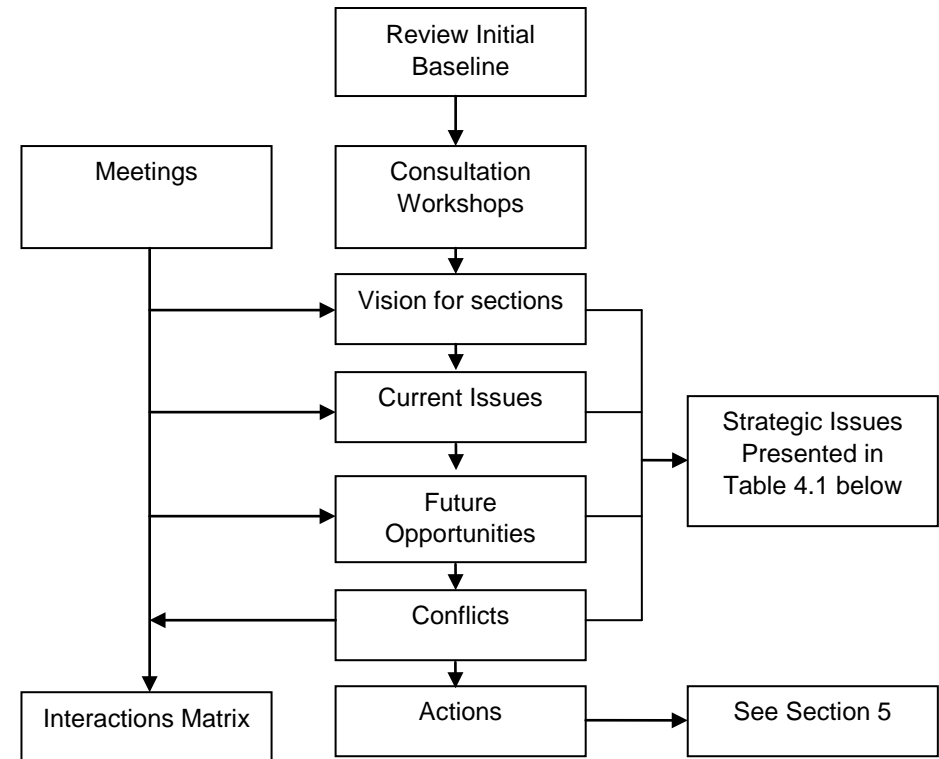
Some marine sectors may not have any long term visions for change or growth. However, their interaction with other marine sectors and the marine environment is still explored as part of this Framework in order to identify whether any actions are required to either address any current issues or overlapping interests, or to reduce the potential for future conflict as a result of growth or change within other sectors.

This Framework document also recognises that there are a number of interactions that already occur between different marine sectors and the environment, a large proportion of which are compatible, and therefore would need to be maintained or managed, rather than changed.

Approach to Identifying Key Issues and Interactions

Diagram 4.1 provides an overview of the approach taken to the identification of strategic issues and interactions. This is based around information obtained from the consultation workshops.

Diagram 4.1: Approach to Identifying Key Issues and Interactions



Interactions Matrix

The aim of the interactions matrix is to simply illustrate where an interaction is likely to occur between different marine sectors and activities and the likely extent of that interaction e.g. small, medium, large. The interaction matrix at this stage DOES NOT provide any assessment of whether an interaction is positive or negative. The interaction matrix is presented after the summary of strategic issues and possible solutions/opportunities below.

SECTION 4: STRATEGIC ISSUES AND INTERACTIONS

Table 4.1 below provides a summary of the main strategic issues and associated possible solutions identified from a review of existing, available baseline data and from the consultation workshops and additional supplementary meetings.

Table 4.1: Strategic Issues

Marine Sectors	Strategic Issues identified to date – this list will be subject to ongoing review as part of the preparation of a statutory MSP for the Pentland Firth and Orkney Waters	Possible Opportunities (note: not all of these are deliverable by the MSP)
Natural Environment and Heritage	<ul style="list-style-type: none"> § Increased protection – required through legislation e.g. OSPAR, MSFD and Marine (Scotland) Act § Need to adopt ecosystem approach to management of environment but there currently exists limited knowledge on relevant ecosystems. § Data gaps relating to: <ul style="list-style-type: none"> ∅ Species and habitat abundance and distribution ∅ Identification of keystone species § Knowledge gaps relating to: <ul style="list-style-type: none"> ∅ Effects of climate change on habitats, species and ecosystems (including keystone species) ∅ Effects of other marine sectors on habitats, species and ecosystems § Need for increased awareness of value and importance of marine environment. § Local designations currently apply to mainly terrestrial and coastal areas. § Threat of coastal erosion and sea level rise on archaeology. § Nutrient enrichment of coastal waters from Mariculture and agricultural runoff. § Industrial other discharges into coastal waters.. § Effects of climate change on water quality – salinity and pollution from increased runoff. 	<ul style="list-style-type: none"> § Further studies, surveys and research. § Collaborative working – data sharing and systematic surveying. § Application of research deploy and monitor approach to the development of marine renewables. § Standard methodologies for data collection and surveying, taking into account Marine Scotland’s existing survey work. § Communication and consultation. § Avoiding piecemeal development. § Centres of excellence in data collection and management of marine sectors and environmental protection – sell skills, experience and knowledge elsewhere.

Marine Sectors	Strategic Issues identified to date – this list will be subject to ongoing review as part of the preparation of a statutory MSP for the Pentland Firth and Orkney Waters	Possible Opportunities (note: not all of these are deliverable by the MSP)
Renewable Energy	<p>§ Need to realise opportunity for Scotland to become world leader in combating climate change and in development of renewable energy technologies. Need to recognise risks or barriers to achieving this:</p> <ul style="list-style-type: none"> Ø Lack of grid infrastructure. Ø Uncertainty in relation to understanding interactions with other marine sectors and need to avoid conflicts. Ø Availability of necessary infrastructure (ports and harbours and land based infrastructure) in time to support growth of industry. Ø Need to meet requirements of environmental legislation e.g. Habitats Directive – timescales and implications in requirement for evidence. Ø The timescales for marine spatial planning in relation to development. Some development proposals will proceed in advance of the statutory MSP. Ø Competition to become established world leader from other countries e.g. Europe and Canada. <p>The Crown Estate Commissioners' decision not to hold future leasing rounds in this area - possible limit on development potential for wave and tidal energy</p>	<ul style="list-style-type: none"> § Centre of excellence (technologies and development e.g. managing conflict) – linked to green visitor centre. § Communication and knowledge sharing. § Cooperation between Orkney and Caithness. § Cooperation between stakeholders. § Export renewable energy. § Employment opportunities in servicing, maintenance and manufacture. § Energy storage. § Improved infrastructure (local). § Low carbon economy. § Community energy projects. § Need to coordinate development of resource with provision of grid across region.
Shipping and Navigation	<ul style="list-style-type: none"> § Current high volume of traffic in Pentland Firth possible conflict with marine renewable energy developments. § Need to safeguard ferry routes. 	<ul style="list-style-type: none"> § Coordination of vessel movements. § Navigation liaison/consultation group to help manage marine renewable energy developments. § Clustering of development to minimise disruption and hazard to shipping.
Ports and Harbours	<ul style="list-style-type: none"> § Insufficient capacity in existing ports to support deployment and maintenance of full scale commercial marine renewable energy projects. § Need to improve port and harbour facilities and associated infrastructure to provide sufficient construction areas, access for large vessels carrying large devices or parts, appropriate craning and lay down facilities, good access to offshore development sites (location), 24 hour access all year, road access. § Risk that current port and harbour activities e.g. ferry or fishing activities, will be disrupted by marine renewable energy industry developments. § Improvements to Scrabster Harbour are reliant on private investment. 	<ul style="list-style-type: none"> § Require investment – Government led § Increased stakeholder engagement § Coordination of harbour improvements across Caithness and Orkney to maximise wider benefits and ensure even spread of services. § Potential employment opportunities in harbour extensions and improvements and longer term servicing and maintenance. § Safeguard access to ports and harbours for ferries. § Business development opportunities. § Opportunities to provide improved tourist facilities for cruise ships.

Marine Sectors	Strategic Issues identified to date – this list will be subject to ongoing review as part of the preparation of a statutory MSP for the Pentland Firth and Orkney Waters	Possible Opportunities (note: not all of these are deliverable by the MSP)
Other Infrastructure	<ul style="list-style-type: none"> § Growth of the wave and tidal industry requires significant investment in land side infrastructure e.g. substations, construction, maintenance and serving facilities, housing for developers and contractors. § There may also be longer term requirements for manufacturing facilities or innovation/design centres of excellence. § Risk of increased tidal flooding from sea level rise and increase storminess. 	<ul style="list-style-type: none"> § Both Orkney Island Council and Highland Council have identified in their Main Issues Reports the need to identify potential locations for the provision of supporting infrastructure such as substations, facilities for manufacturing, assembly, servicing and maintenance. § Require structured and coordinated approach to development and provision of infrastructure to support marine renewable energy developments. § Knock on effects on wider infrastructure improvements with benefits on tourism and economic investment.
Commercial Fisheries and Mariculture	<ul style="list-style-type: none"> § Lack of knowledge of offshore fisheries. § No clear framework for regulation or coordination of activities. § No clear guidance on acceptable activities within Natura sites or MPAs. § Port facilities expensive and not adequate to support large volume fisheries. § Competition for space between fisheries and marine renewables. § Increased pressure for space from large Mariculture installations. 	<ul style="list-style-type: none"> § MPAs may have potential benefits on fishing stocks by creating exclusion zones. § Potential opportunities to use skills and local knowledge of fishermen to assist marine renewable energy industry § Greening fishing practices.
Tourism and Recreational Development	<ul style="list-style-type: none"> § Need for clear branding and promotion of North Highlands coast. § Lack of good tourist facilities and accommodation in North Highlands coast. § Conflict at ports between commercial activities and tourism e.g. promoting cruise ships (Orkney and Caithness). 	<ul style="list-style-type: none"> § Better promotion attractions of North Caithness coast – watersports and outdoor activities. § Green visitor centres – links to marine renewable energy Industry. § Better coordination of port and harbour activities and developments and tourism requirements. § Improved infrastructure – link to marine renewable energy industry to maximise benefits.
Oil and Gas and Aggregate Extraction	<ul style="list-style-type: none"> § Decline of oil and gas industry across Scotland and impact on Orkney and North Highlands Coast. § Possible competition for sites for carbon storage with wave and tidal developments. § Cumulative effects of increased subsea cables for commercial wave and tidal developments and possible subsea interconnectors required as part of grid reinforcements. § Need for increased subsea telecommunications links to support infrastructure improvements. 	<ul style="list-style-type: none"> § Coordination of subsea grid infrastructure and marine renewable energy developments. § Economic benefits from marine renewable energy industry may help reduce impact of oil and gas decline.

SECTION 4: STRATEGIC ISSUES AND INTERACTIONS

Table 4.2 provides a summary of the main interactions that are likely to occur between the different marine sectors and activities and the likely level of interaction. This matrix does not include an assessment as to whether an interaction will be positive or negative as there are a wide range of factors that will influence the overall nature of the interaction including for example location and possible options/solutions that can be implemented to reduce or avoid any interactions or limit the potential for the interactions that do occur to be negative. This reflects the overall approach to the preparation of this MSP which is to focus on identifying solutions to resolving or avoiding interactions and overlapping interests as part of the marine spatial planning process rather than focusing on identifying constraints to development in certain locations or the segregation of different sectors and activities where, with appropriate management, intervention and coordinated working co-existence could occur. This interaction matrix will be refined and updated during stage 2 of the development of the MSP, as more detailed information on different sectors and activities is generated.

Table 4.2: Interaction Matrix

	Protected Sites and species (including MPAs)	Local designations	Geology and Geomorphology	Seascape/Landscape	Marine and Coastal Archaeology and Heritage	Water Quality	Air Quality	Climate	Marine Renewables	Offshore Wind	Grid Connections and Reinforcement	Shipping and Navigation (including ferries and recreational sailing)	Ports and Harbours	Other Infrastructure	Commercial Fisheries	Mariculture	Recreation and Tourism	Carbon storage	Oil and gas	Aggregate extraction
Protected Sites and species (including MPAs)	Neutral	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Local designations	Neutral	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Geology and Geomorphology	Neutral	●	●	●	●	●	No Interaction	●	●	●	●	●	●	●	●	No Interaction	No Interaction	●	●	●
Seascape/Landscape	Neutral	●	●	●	●	●	No Interaction	●	●	●	●	●	●	●	●	No Interaction	●	●	●	●
Marine and Coastal Archaeology and Heritage	Neutral	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Key: Large interaction (positive or negative) = ●, Medium interaction (positive or negative) = ●, Small interaction (positive or negative) = ●

No interaction = No Interaction, Same sector/activity = Neutral

	Protected Sites and species (including MPAs)	Local designations	Geology and Geomorphology	Seascape/Landscape	Marine and Coastal Archaeology and Heritage	Water Quality	Air Quality	Climate	Marine Renewables	Offshore Wind	Grid Connections and Reinforcement	Shipping and Navigation (including ferries and recreational sailing)	Ports and Harbours	Other Infrastructure	Commercial Fisheries	Mariculture	Recreation and Tourism	Carbon storage	Oil and gas	Aggregate extraction	
Water Quality						Neutral	No Interaction	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Air Quality						Neutral	●	No Interaction	No Interaction	No Interaction	●	●	●	●	No Interaction	No Interaction	No Interaction	●	●	No Interaction	No Interaction
Climate						Neutral	●	●	●	●	●	●	●	●	●	●	●	●	●	●	No Interaction
Marine Renewables						Neutral	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Offshore Wind						Neutral	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Grid Connections and Reinforcement						Neutral	●	●	●	●	●	●	●	●	●	●	No Interaction	No Interaction	No Interaction	No Interaction	No Interaction
Shipping and Navigation (including ferries and recreational sailing)						Neutral	●	●	●	●	●	●	●	●	●	●	●	No Interaction	No Interaction	No Interaction	No Interaction
Ports and Harbours						Neutral	●	●	●	●	●	●	●	●	●	No Interaction	●	●	●	●	●
Other Infrastructure						Neutral	●	●	●	●	●	●	●	●	●	No Interaction	No Interaction	●	No Interaction	No Interaction	No Interaction

Key: Large interaction (positive or negative) = ●, Medium interaction (positive or negative) = ●, Small interaction (positive or negative) = ●

No interaction = No Interaction, Same sector/activity = Neutral

	Protected Sites and species (including MPAs)	Local designations	Geology and Geomorphology	Seascape/Landscape	Marine and Coastal Archaeology and Heritage	Water Quality	Air Quality	Climate	Marine Renewables	Offshore Wind	Grid Connections and Reinforcement	Shipping and Navigation (including ferries and recreational sailing)	Ports and Harbours	Other Infrastructure	Commercial Fisheries	Mariculture	Recreation and Tourism	Carbon storage	Oil and gas	Aggregate extraction
Commercial Fisheries															Neutral	●	●	●	●	●
Mariculture															Neutral	●	●	No Interaction	No Interaction	●
Recreation and Tourism																Neutral	No Interaction	No Interaction	No Interaction	No Interaction
Carbon storage																	Neutral	●	●	
Oil and gas																		Neutral	●	
Aggregate extraction																				Neutral

Key: Large interaction (positive or negative) = ●, Medium interaction (positive or negative) = ●, Small interaction (positive or negative) = ●

No interaction = No Interaction, Same sector/activity = Neutral

SECTION 4: STRATEGIC ISSUES AND INTERACTIONS

SUMMARY OF KEY INTERACTIONS

The following provides a brief discussion of some of the key areas where there is potential for interactions to occur between different marine sectors and activities.

Climate

Climate has been identified as a cross cutting theme rather than a specific marine sector. Ultimately climate change and the need to combat and adapt to climate change underpins how certain sectors and activities are currently being managed and are likely to need to be managed in the future.

In terms of Natural Environment and Heritage the uncertainty surrounding future climate change and its impact on water quality, salinity, sea temperatures and the knock on effects of that on the abundance and distribution of certain species and habitats is a key consideration. This is recognised through the EU Marine Strategy Framework Directive (MSFD) which identifies the need to adopt an ecosystem approach to the management and protection of the marine environment. This reflects the fact that whilst the protection of individual species is essential for maintaining biodiversity, it is also necessary to protect the wider ecosystem to improve their robustness and ability to adapt to change induced by climate change and other activities, even if the abundance or distribution of a certain species changes.

Climate, and potential changes in climate, is also a key factor in terms of coastal erosion. Possible increased storminess, storm surges and sea levels are likely to place increased pressure on coastal areas, leading to increased risk of erosion. In Orkney, the threat of increased coastal erosion on Skara Brae and other features of archaeological importance along the west coast is a current concern for which solutions for increasing coastal defences are being sought. There may also need to be increased protection of coastal elsewhere to protect property and other key features e.g. landscapes and geological and geomorphological sites.

Whilst the precise effects of climate change on commercial fishing activities and mariculture are still to be determined, there is concern over declining fish stocks and increased risk of disease in fish farms. The ecosystem approach to the management of the marine environment should help to alleviate these potential effects by strengthening the ecosystems that support commercial fish stocks.

One of the main drivers for the development of marine renewable energy (and offshore wind) in the Pentland Firth and waters around Orkney, is combating climate change and meeting Scotland's target for meeting 80% of Scotland's gross electricity energy demand from renewable energy sources by 2020. Growth of this industry is also seen as an opportunity for Scotland to become a world leader in the development and deployment of renewable energy technologies and a main exporter of electricity generated from renewable sources. Climate change will itself impact on future marine renewables resource assessments.

Marine Renewable Energy and Offshore Wind

There are a range of potential interactions between marine renewable energy and offshore wind developments and other marine sectors. These include:

- § Environment and Heritage mainly:
 - ∅ Protected sites and species (seabirds, marine mammals including seals, dolphins, porpoise and whales, marine reptiles and fish)
 - ∅ Marine Protected Areas (MPAs)
 - ∅ Geology and coastal processes
 - ∅ Seascape quality
 - ∅ Archaeological and built heritage
- § Shipping and navigation
- § Ferries
- § Recreational sailing
- § Ports and harbours
- § Commercial fishing
- § Aquaculture
- § Oil and gas and telecommunications

It should be noted that not all of the interactions identified above are negative. In some cases e.g. the interaction of marine renewable energy developments with seabirds, marine mammals and fish, the interaction is not fully understood and further work is required to determine the exact nature and extent of the likely interactions that could occur.

SECTION 4: STRATEGIC ISSUES AND INTERACTIONS

However, for this to be achieved there is a requirement to undertake a number of research studies and surveys to gain further understanding of marine environment and interactions with marine renewable energy developments. A number of these studies have been commissioned or are in the process of being commissioned.

The information obtained from these research studies and surveys will be critical to informing the development of future policies for inclusion in a statutory MSP for the area. These studies and surveys are recognised in this Framework along with recommendations for further consultation and the establishment of strategies to manage the deployment of marine developments with respect to wider environmental monitoring and protection.

A number of the other possible interactions identified with other marine sectors and activities relate to competition for space. One of the roles of the MSP process will be to explore options for coexistence between sectors and activities. Where this is not possible, it will be necessary, as part of the MSP process to prioritise certain uses/activities in certain locations.

The role of the MSP is to support current and existing activities as well as to facilitate the sustainable growth and development of other sectors. It will do this taking into account feedback from stakeholders, as well as by considering relevant existing policy priorities at local and national level.

In terms of marine renewables it is likely that each area will need to be examined to explore the different interactions that occur within a certain location. Part of this area based analysis has already been undertaken as part of the Regional Locational Guidance. Any policies developed either for that location or activity/sector will therefore need to be flexible to ensure they adequately reflect the different priorities in different areas and are able to respond to any future changes in those priorities.

Grid Connection and Reinforcement

The increase in energy generation through the development of renewable energy throughout this area will require infrastructure to connect individual generating plant together, new export cables, substations and transmission grid reinforcement. The coherent planning of export cables and substations from areas assessed as suitable for commercial development will require co-ordination. Onshore transmission grid reinforcements are currently being planned by National Grid and SHETL, and will be subject to existing planning and environmental

controls. Subsea interconnectors are also being planned by the same bodies. The timing of delivery of the necessary grid reinforcements and the commissioning of renewable energy developments will be key to confidence in investment in both the renewable energy developments and the grid infrastructure being mutually supportive.

Shipping and Navigation

Other than possible interactions with marine renewable energy and offshore wind developments in certain locations, there are also likely to be interactions with the natural environment and heritage and ports and harbours developments.

One of the main risks with shipping and navigation activities in the Pentland Firth is the accidental release of oil or other hazardous substance from oil tankers or cargo ships. There are also possible interactions relating to CO₂ emissions from increased vessel movements.

Both the risk of accidental spillage of oil and hazardous substances and increased CO₂ emissions could increase as a result of vessels having to extend or divert routes to avoid offshore renewable energy development areas. This potential risk and the implications on marine safety will need to be included in the development of appropriate policy for this sector.

Commercial Fishing and Mariculture

Mariculture sites are presently located in the more sheltered bays and sounds within the Orkney Islands. Although requiring a reasonable tidal current for their operations, they would not tend to be located in the more energetic areas sought by tidal or wave developments and there is unlikely to be a direct interaction.

The major commercial demersal and pelagic fishing takes place in grounds generally outwith the 12 nautical mile limit. Smaller vessels operate for crab, lobster and scallops within nearshore areas.

Any possible interaction between commercial fishing and mariculture, and planned marine renewables activities will have to be assessed and considered in the setting of policy priorities in future development of the plan.

The effects of possible displacement due to other activities will have to be considered alongside potential beneficial effects. Fishing vessels, large and small,

SECTION 4: STRATEGIC ISSUES AND INTERACTIONS

will also be affected in terms of navigation interest in a similar manner to major shipping by the location of marine energy developments.

Other Infrastructure

Existing seabed infrastructure is generally limited to pipelines and cables. The routes of these are well known and can be avoided for any new developments. A key pipeline is the one serving Flotta oil terminal.

SECTION 5: MAIN RESEARCH AND DATA COLLECTION PRIORITIES FOR THE MSP

INTRODUCTION

The future MSP for the Pentland Firth and Orkney Waters will provide the context in which conflicts between different sectors can be resolved and by which certain areas can be defined for key uses. Based on the evidence set out in the Sections above and the issue raised in Part 2 of this document, the RLG for Marine Energy, this Section summarise the main research and data collection priorities and actions to be addressed by the future MSP for this region. As explained in Section 2 above, the MSP is being prepared in three stages. Under stage 2 a number of additional studies will be undertaken in order to cover all identified gaps in knowledge or required information to develop a comprehensive MSP. In Table 5.1 below these are identified as Actions.

SECTION 5: MAIN RESEARCH AND DATA COLLECTION PRIORITIES FOR THE MSP

Table 5.1: Main Research and Data Collection Priorities and Actions for the MSP

Marine Sectors		Main Research and Data Collection Priorities and Actions for the MSP
Natural Environment and Heritage	Biodiversity including Protected Sites and Species	<p>The Marine (Scotland) Act contains a new power to designate Marine Protected Areas (MPAs) to protect species and habitats of national importance. MPAs will be identified in the MSP and policies will be put in place for the protection of these sites.</p> <p>With respect to Natura sites, the MSP will need to ensure the policies relating to other sectors (such as marine energy) do not promote development in a manner which would have significant impacts on the conservation objectives for these sites. There will be a need for developments, individually or cumulatively, to demonstrate no significant impact on the integrity of Natura sites. The MSP will be subject to both Strategic Environmental Assessment and Appropriate Assessment and these processes will play an important role in formulating policies. However, it is recognised that marine energy developments may proceed in advance of the adoption of the MSP. It is also recognised that there is considerable uncertainty over the effects of marine energy development on certain habitats and species. A number of Actions are therefore necessary to overcome these uncertainties and provide support for future SEAs and Appropriate Assessments including:</p> <p>Actions</p> <p>§ To ensure an adequate baseline to enable better understanding of ecosystem process and function, guide any future designation of MPAs and to determine any effects of marine energy development, This baseline to rely on data collection and research including: Diving Birds Strategic Monitoring, Marine Mammals Strategic Monitoring, Marine Electrical Cable Influence on migratory fish.</p> <p>§ Agree survey, deploy and monitor strategy for marine energy development.</p>
	Seascape	The MSP will set out policies for the protection of the seascape, as well as key views of the land from the sea. These policies should be consistent with local land use policies, extending their protection into the marine environment.
	Heritage	<p>The MSP will set out policies for the protection of marine heritage.</p> <p>The Marine (Scotland) Act contains a new power to designate Historic MPAs. This new power broadens the scope of the types of historic assets that can be protected.</p>

Marine Sectors		Main Research and Data Collection Priorities and Actions for the MSP
Renewable Energy	Marine Renewable Energy	<p>The MSP will contain policies supporting marine energy developments in a manner consistent with other policy objectives and with legislative requirements.</p> <p>Areas of high tidal stream and wave resource often coincide with other activities and marine resources, and in some instances overlapping uses may not be compatible. This is explored in detail in the RLG. In order to assess the degree to which different uses of the marine environment can be mutually compatible, it will be necessary to ensure that a set of research studies is completed.</p> <p>Actions:</p> <p>To understand the degree to which marine energy capabilities can be developed and co-located alongside other users of the sea,</p> <ul style="list-style-type: none"> § Marine renewable energy study <p>To ensure the completion of studies to understand the contribution of different sectors to the economy, including:</p> <ul style="list-style-type: none"> § Tourism and recreation study § Navigation Traffic Management Study § Ports and harbours facilities assessment § Fishing resource assessment <p>See Actions below.</p>
	Grid Infrastructure and Reinforcement	<p>The MSP will set out policies which will aim to guide the development grid infrastructure in manner which:</p> <ul style="list-style-type: none"> § Ensures that the effects on the marine environment are minimised. § Ensures that a co-ordinated approach is taken with land use planning. § Encourages co-operation between developers.
Shipping and Navigation	Shipping and Navigation	<p>It will be necessary to understand in more detail the spatial and temporal extent of commercial and recreational shipping and boating activities, their contribution to the local and national economies, and the extent to which they can be co-located with other sectors, in particular marine renewables,</p> <p>Action:</p> <ul style="list-style-type: none"> § To undertake Navigation Traffic Management Study.

Marine Sectors		Main Research and Data Collection Priorities and Actions for the MSP
	Ferries	<p>The MSP will set out policies to safeguard ferry routes to maintain vital links between communities. Marine energy resource areas, particularly tidal stream, overlap with ferry routes across the Pentland Firth and between the Orkney Islands. In order to facilitate other policy objectives, including marine energy development, it will be necessary to assess the degree to which ferry routes can be co-located with marine renewables and agree measures to avoid any conflicts between the two activities,</p> <p>Action:</p> <p>§ As part of the proposed Navigation Traffic Management Study it will be necessary to consider any effects on ferry operations and agree the measures necessary to allow marine energy development to proceed without compromising essential ferry services.</p>
Ports and Harbours	Ports and Harbours	<p>It will be necessary to include policies within the MSP supporting the development of facilities to cater for marine energy and other marine activities such as oil and gas, fishing and recreational boating. It will also be necessary to understand the effects on the marine environment of these proposals in order that protection measures can be incorporated into the MSP. In order to achieve this it will be necessary to better understand the resource needs within ports and harbours, the location of development and its scale. This work is informed by the National Renewables Infrastructure Plan (stage 2).</p> <p>Action:</p> <p>To work with SE and HIE to understand the developing needs of wave and tidal developers and to ensure a Ports and Harbours Facilities Assessment is carried out.</p>
Other Infrastructure	Coastal defence	<p>The MSP will set out policies supporting the development of essential coastal defences and other infrastructure in accordance with Scottish Planning Policy. The responsibilities of the MSP will depend on the type of infrastructure and its location.</p>
	Other infrastructure	
Commercial Fisheries and Mariculture	Commercial Fisheries	<p>The MSP will set out policies for Mariculture development consistent with those set out in land use plans. In general, the extant land use plan for Orkneys contains a presumption in favour of development subject to meeting other policy objectives, particularly relating to the environment.</p> <p>There is a lack of detailed information on the spatial extent of commercial fishing and its associated economic and social benefits for this geographic area.</p>

Marine Sectors		Main Research and Data Collection Priorities and Actions for the MSP
	Mariculture	<p>Action:</p> <p>Undertake a Fishing Resource Assessment to map the spatial distribution of commercial fishing around Pentland Firth and Orkney and to estimate the economic value of different fishing locations. This assessment will be used to identify potential effects on commercial fish landing values from differing levels of potential marine renewable energy development and will feed into the proposed socio-economic study. See actions below</p>
Tourism and Recreational Development	Recreational Boating	<p>The MSP will need to consider the interactions between these activities and other sea users, in particular marine energy developments.</p> <p>Action:</p> <p>§ As part of the proposed marine socio-economic study, it will be necessary to obtain data on the contribution of marine related tourism and recreation to the local economy.</p>
	Watersports	
Mineral Resources	Oil and Gas	<p>The MSP will need to consider policies aimed at avoiding conflicts with other sea users, and where appropriate facilitating development in a manner consistent with other policy objectives.</p>
	Aggregate Extraction	<p>There are no aggregate extraction activities within the broad area, nor are any envisaged. No action is required on this topic.</p>
Defence		<p>The MSP will need to consider the relevant defence activities in this area and determine their likely interaction with others covered in the plan.</p> <p>Action:</p> <p>§ Identify relevant defence activities</p>

SECTION 5: MAIN RESEARCH AND DATA COLLECTION PRIORITIES FOR THE MSP

KEY ACTIONS FOR STAGE 2

Marine Scotland will commence the second stage of MSP development (see Section 2 above) by commissioning a series of projects where information on marine issues is required to adequately populate the future MSP. Some of these studies have already commenced.

The types of studies which have emerged as necessary to further populate the MSP Framework or provide supporting SEA and Appropriate Assessment reporting are summarised below. Many of these studies relate directly to marine energy as this is the area of new development that has the greatest interaction with other sea users and the greatest degree of uncertainty. The Actions integrate the findings of the RLG (see Part 2 below).

- § Environmental studies, including
 - ∅ Diving Birds Strategic Monitoring
 - ∅ Marine Mammals Strategic Monitoring,
 - ∅ Marine Electrical Cable Influence on migratory fish
- § Survey, Deploy and Monitor Strategy for Marine Energy development
- § Socio Economic Assessment, relying on:
 - Marine renewable energy study
 - Tourism and recreation study
 - Navigation Traffic Management Study
 - Ports and Harbours facilities assessment.
 - Fishing Resource Assessment
- § Defence study

Further information on each of these is provided below.

Environmental Studies

There is a lack of data on the presence of particular species across the study area. This data is needed to inform a better understanding of the ecosystem(s), to aid designation of any future MPAs and to ascertain how different species will be affected by different marine energy technologies. It will be necessary to

undertake a number of additional studies to inform the future MSP and the accompanying SEA and AA. These studies will include but are not limited to:

- § Diving Birds Strategic Monitoring
- § Marine Mammals Strategic Monitoring
- § Marine Electrical Cable Influence on migratory fish

Marine Scotland and the Scottish Government Environment team have agreed a course of action and study specifications with Scottish Natural Heritage, broad scale bird and mammal surveys throughout the Pentland Firth and Orkney Waters, focussed on areas of interest for commercial scale developments.

Survey, Deploy and Monitor Strategy for Marine Energy development

Marine Scotland believes that a 'survey, deploy and monitor' approach is the most appropriate way to facilitate marine energy development in a manner which is consistent with Natura legislation. The approach promotes staged development in combination with the monitoring of the effects on the conservation objectives of Natura sites. Marine Scotland will establish a detailed method for a survey, deploy and monitor strategy in collaboration with SNH and JNCC. In summary, the approach involves an initial risk assessment to decide if the proposed development requires a minimum, moderate or maximum risk based approach. This then governs the subsequent staged deployment and monitoring of the development as follows:

In order for this approach to be effective it will be necessary:

- § To agree methodologies with regulatory authorities.
- § For developers to monitor their devices or arrays, advised by regulatory authorities on the most appropriate way of doing this. This will need to be undertaken in a number of locations and for a variety of species.
- § To facilitate the sharing of data between developers.

SECTION 5: MAIN RESEARCH AND DATA COLLECTION PRIORITIES FOR THE MSP

Socio Economic Assessment

It will be essential to understand the contributions that different sectors make to the local and national economy in order to develop an effective MSP that supports sustainable development.

While much local economic data is available the data is fragmented and not specific to marine areas or activities. The importance of marine activities to the local and national economy and communities needs to be better understood both in formulating policies and in order to monitor the effectiveness of the MSP. This will be particularly important when considering the potential for future development of the marine renewables sector. It will be necessary to estimate how development of this sector may impact on other sectors.

Other sector-specific studies discussed below, such as tourism and recreation, the navigation traffic management study, ports and harbours facilities assessment, and fishing resource assessment will feed into this socio-economic study.

It is important to recognise the contribution that the marine environment makes to the well-being and quality of life of people who are resident in, or who visit, this area. This contribution goes beyond any economic assessment and will need to be taken account of in the development of the plan.

Marine Renewable Energy Development Study

Marine Scotland will undertake research to understand how marine renewables developers plan to take forward the developments in this area, and the associated resources required.

Tourism and Recreation study

Marine Scotland will carry out a study of the economic values of tourism and recreational activities in this area.

It will also assess the importance of tourism and other recreational activities to well-being and quality of life for local communities and tourists.

Navigation Traffic Management Study

To understand in more detail the spatial and temporal extent of commercial and recreational shipping and boating activities, their contribution to the local and national economies, and the extent to which they can be co-located with other sectors, in particular marine renewables, Marine Scotland will undertake further research to identify:

Marine Grid and Interconnector Feasibility Studies

There have been a number of grid studies for the Pentland Firth area examining a variety of development scenarios and grid reinforcement options. Arising from these studies there are clear actions for:

- § An Orkney link reinforcement: reinforcement of the existing 33kV subsea cable links by the installation of additional new 132kV AC subsea cables between Orkney and Caithness.
- § Dounreay-Beauly: installation of a second circuit on the existing towers of the 275kV overhead line route between Dounreay and Alness to provide a second circuit.
- § National Grid has also started to co-ordinate actions amongst the potential developers in the current Crown Estate leasing round with a Pentland Firth Grid Group feeding back into the FREDS Marine Energy Group. The objectives of the Pentland Firth Grid Group include:
 - Reduce misaligned timescales between projects and grid
 - “umbrella” applications to support new entrants
 - Identify potential connection options
 - Provide Locational input to the Marine Energy Spatial Planning Group
 - Link to the Pentland Firth Developers Forum
- § Indicative additional transmission options arising from this include a 132kV transmission line from Gills Bay to Dounreay.

There is no need for further initiatives in stage 2 to examine land based grid options, given the current level of activity on this. Marine Scotland will continue to sit on the Pentland Firth Delivery Group, which supports the development of required grid capacity.

SECTION 5: MAIN RESEARCH AND DATA COLLECTION PRIORITIES FOR THE MSP

Ports and Harbours Facilities Assessment

The Scottish Government's Renewables Action Plan was published in June 2009. It proposes a National Renewables Infrastructure Project to develop a spatial framework for port and port-side land and landward infrastructure to support the manufacturing, construction, operation and maintenance of off shore wind, wave and tidal sites.

As part of the Scottish Government's Renewables Action Plan, Scottish Enterprise and Highlands and Islands Enterprise drafted a National Renewables Infrastructure Plan, a clear spatial framework for the development of infrastructure to support offshore wave, wind and tidal industries.

This included an analysis of the investment in ports and harbour infrastructure needed to support Scotland's ambitions to be the green energy capital of Europe.

Stage 1 of the National Renewables Infrastructure Plan was published in February 2010. Stage 2 of this plan focussed on infrastructure needs of the wave and tidal sector in Scotland and was published in July 2010., concluding that it is too early to assess the detailed requirements of wave and tidal developers.

Marine Scotland will work with Scottish Enterprise, and Highland and Islands Enterprise, to ensure that an adequate understanding of the infrastructure needs of wave and tidal developers is developed.

Fishing Resource Assessment

The RLG presents an indicative fishing map showing key areas of activity for vessels more than 15m long. The volume of smaller vessels fishing for crab, lobster and scallops in nearshore areas (i.e. within the 12 nm limit) has not been estimated.

Statistics published by the Scottish Government indicate that the value of fish landings in Orkney was £5.6m in 2008. It is possible to break this down by sub-areas (i.e. onshore landing sites) and by species. But there is no existing detailed information on the spatial distribution of fishing activities and their corresponding economic value. In order to understand how different sectors can coexist and be sustainably developed, it will be necessary to carry out an assessment of which coastal communities are reliant on which types of fishing.

Marine Scotland will undertake further research to identify:

- § Areas fished by all fishing vessels (including those smaller than 15m)
- § Gear types used and species fished
- § Associated economic value of areas fished
- § An assessment of the size of the mariculture sector in this area, including the spatial extent of future planned as well as current fishfarms.

SECTION 6: NEXT STEPS

Next Steps

The stage 2 studies are being taken forward by Marine Scotland in conjunction with key stakeholders.

Alongside the studies, the first steps of developing the policy priorities in the plan will be developed, again with stakeholders, and this work will be consulted on.

Updates on this work will be posted on our website at:

<http://www.scotland.gov.uk/Topics/marine/marineenergy/wave/rlg/pentlandorkney>

APPENDIX A: BASELINE FIGURES: NATURE CONSERVATION AND BIODIVERSITY

Figure A1: Protected Sites and Species, Special Areas of Conservation

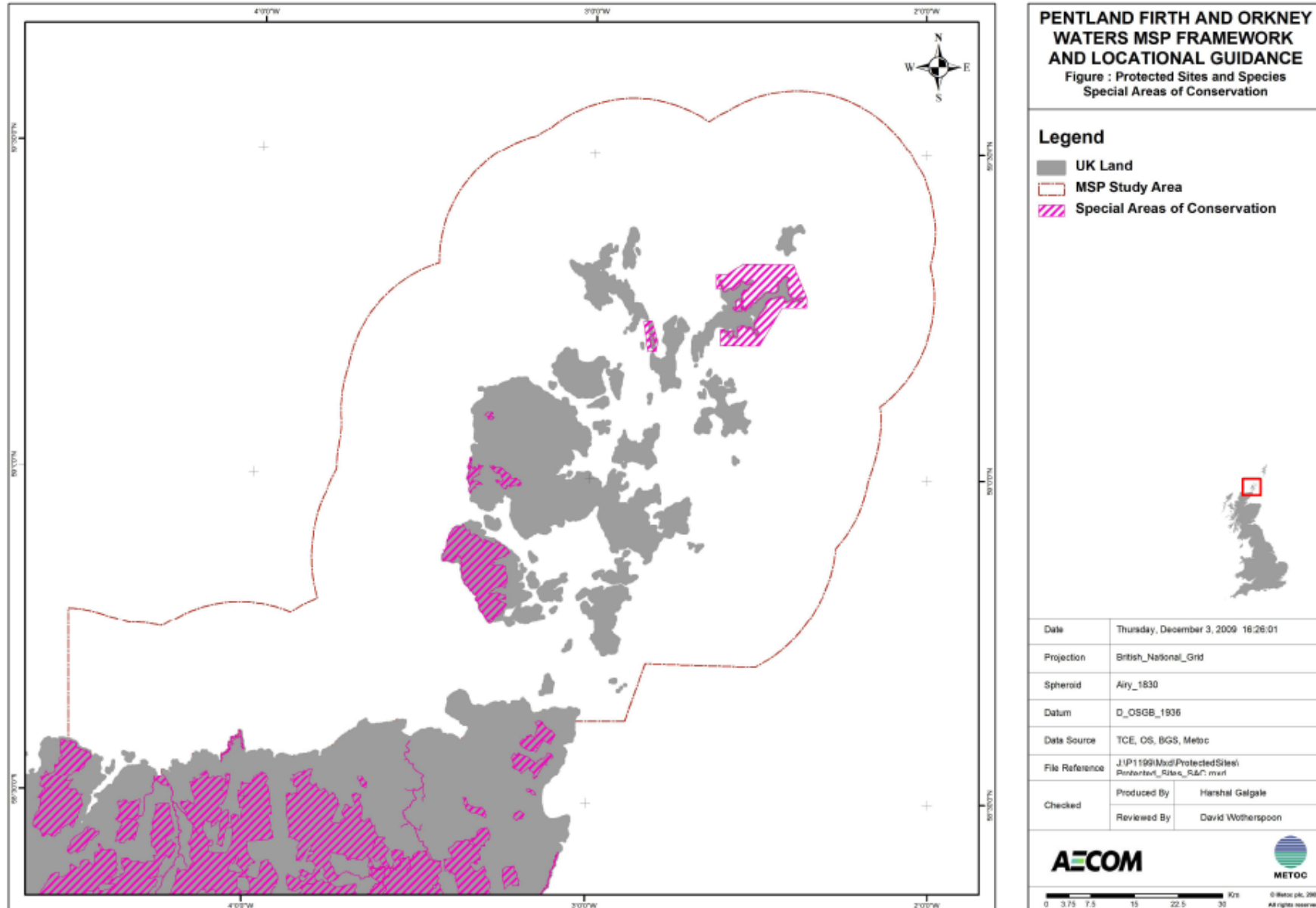


Figure A2: Protected Sites and Species, Special Protection Areas

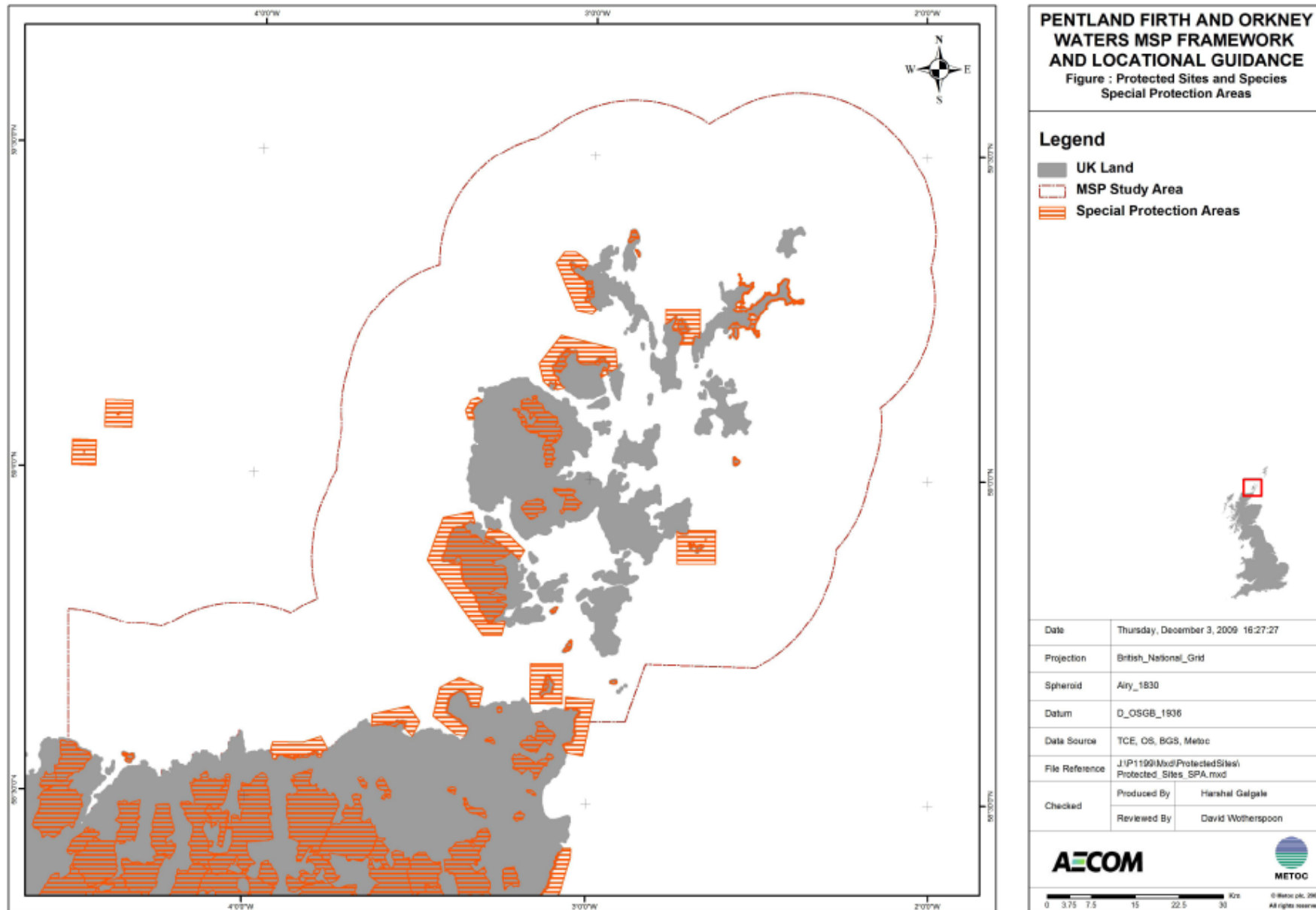
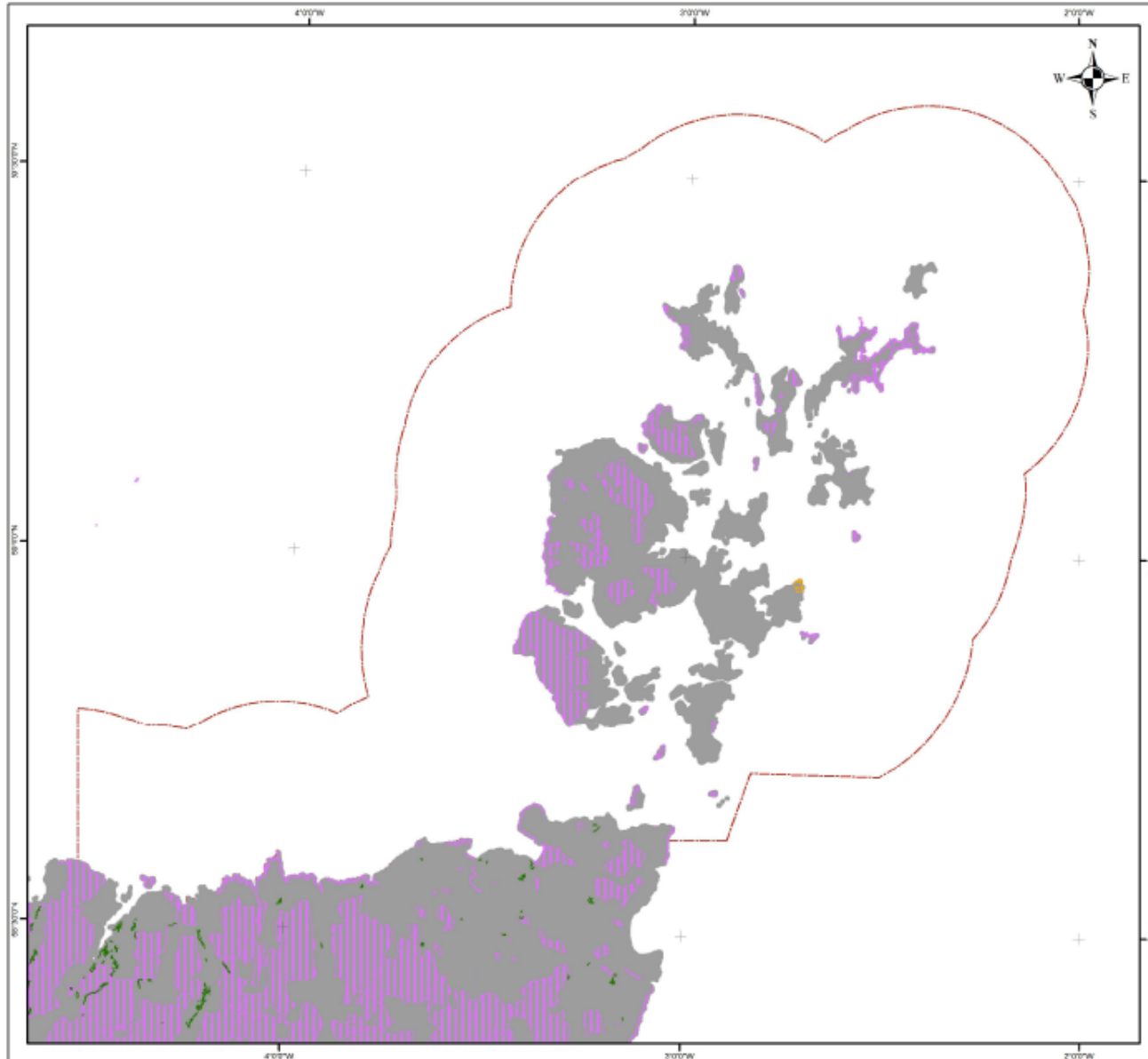


Figure A3: Protected Sites and Species, Woodland, Natural Reserve, Scientific Sites



**PENTLAND FIRTH AND ORKNEY
WATERS MSP FRAMEWORK
AND LOCATIONAL GUIDANCE**
Figure : Protected Sites and Species
Woodland, Natural Reserve, Scientific Sites

Legend

- UK Land
- MSP Study Area
- ▨ Ancient Woodland Inventory
- ▨ Local Natural Reserve
- ▨ Semi-Natural Woodland Inventory
- ▨ Sites of Special Scientific Interest



Date	Thursday, December 3, 2009 16:29:24
Projection	British_National_Grid
Spheroid	Airy_1830
Datum	D_OSGB_1936
Data Source	TCE, OS, BGS, Metoc
File Reference	J:\P1100\Mod\ProtectedSites\Protected_Sites_W_LNR_SSSI.mxd
Checked	Produced By: Harshad Galgale
	Reviewed By: David Wotherspoon

AECOM 

0 3.75 7.5 15 22.5 30 © Metoc plc. 2008. All rights reserved.

Figure A4: Protected Sites and Species, Wetland of International Importance

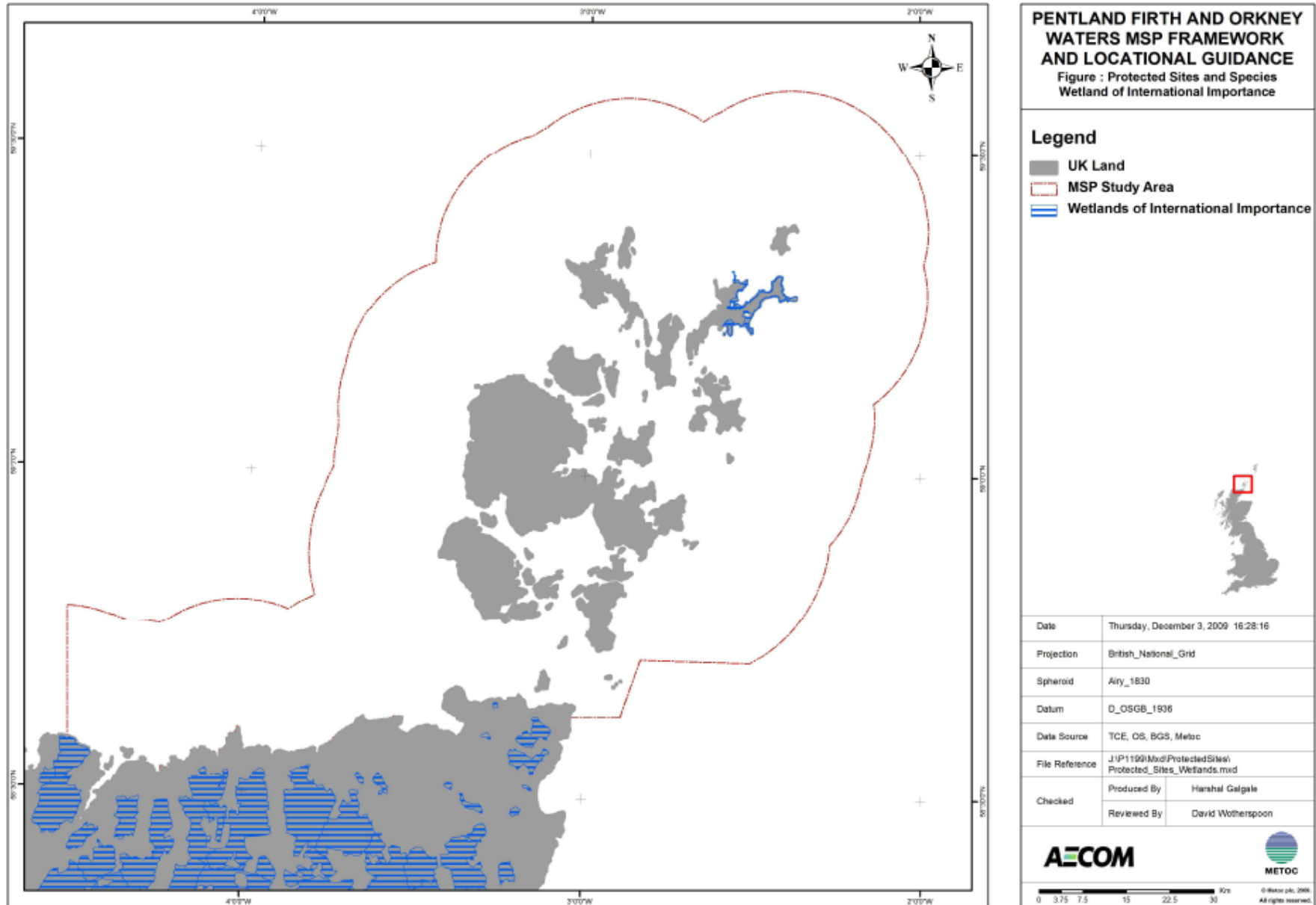


Figure A5: Protected Sites and Species, Important Bird Areas

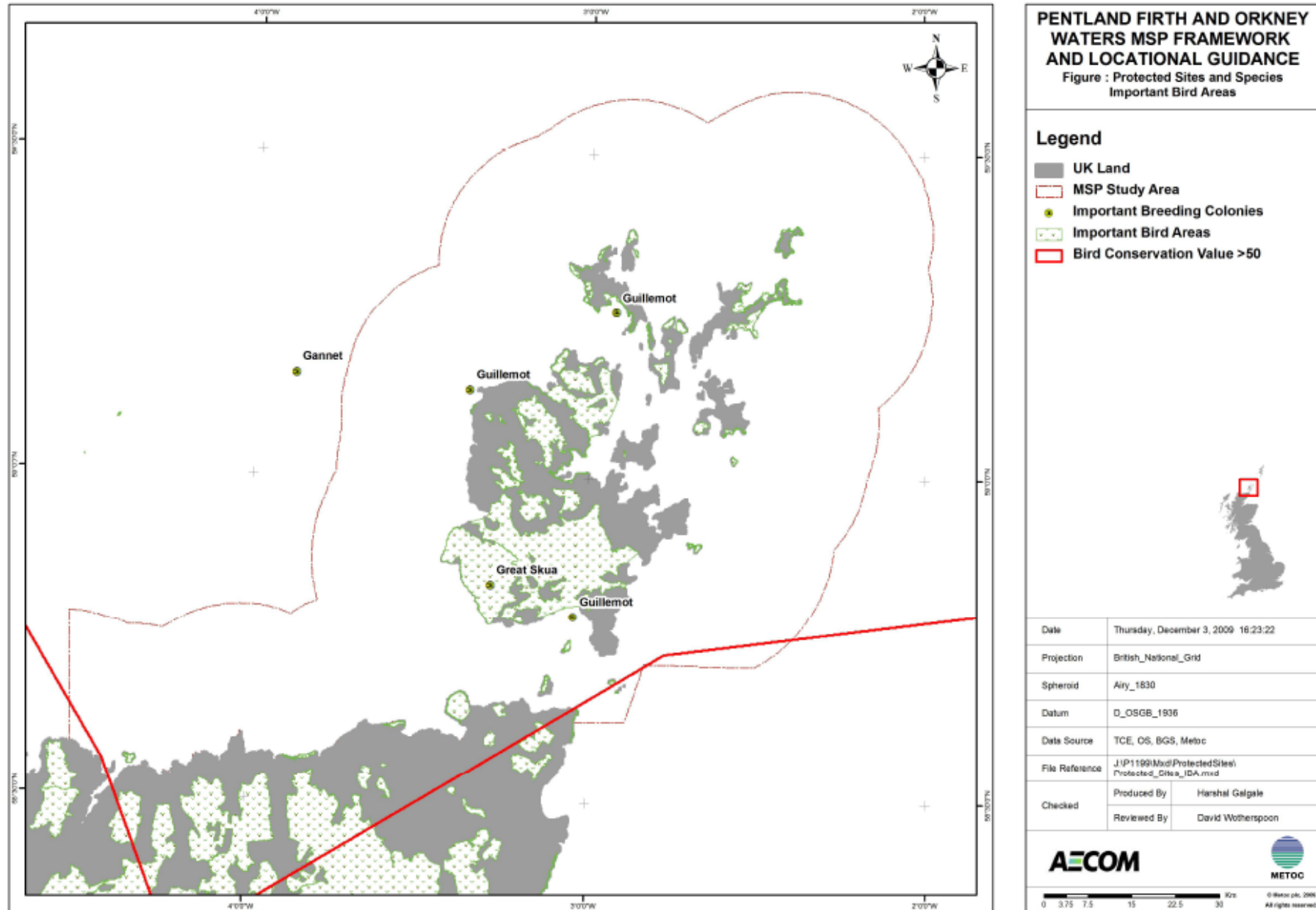


Figure A6: Protected Sites and Species, Marine Consultation Areas




**PENTLAND FIRTH AND ORKNEY
WATERS MSP FRAMEWORK
AND LOCATIONAL GUIDANCE**
Figure : Protected Sites and Species
Marine Consultation Areas

Legend

-  UK Land
-  MSP Study Area
-  Marine Consultation Areas



Date	Thursday, December 3, 2009 16:24:51	
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Checked	Produced By	Harshal Galgale
	Reviewed By	David Witherspoon

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0 3.75 7.5 15 22.5 30 Km © Metoc plc, 2008. All rights reserved.

Figure A7a: Protected Sites

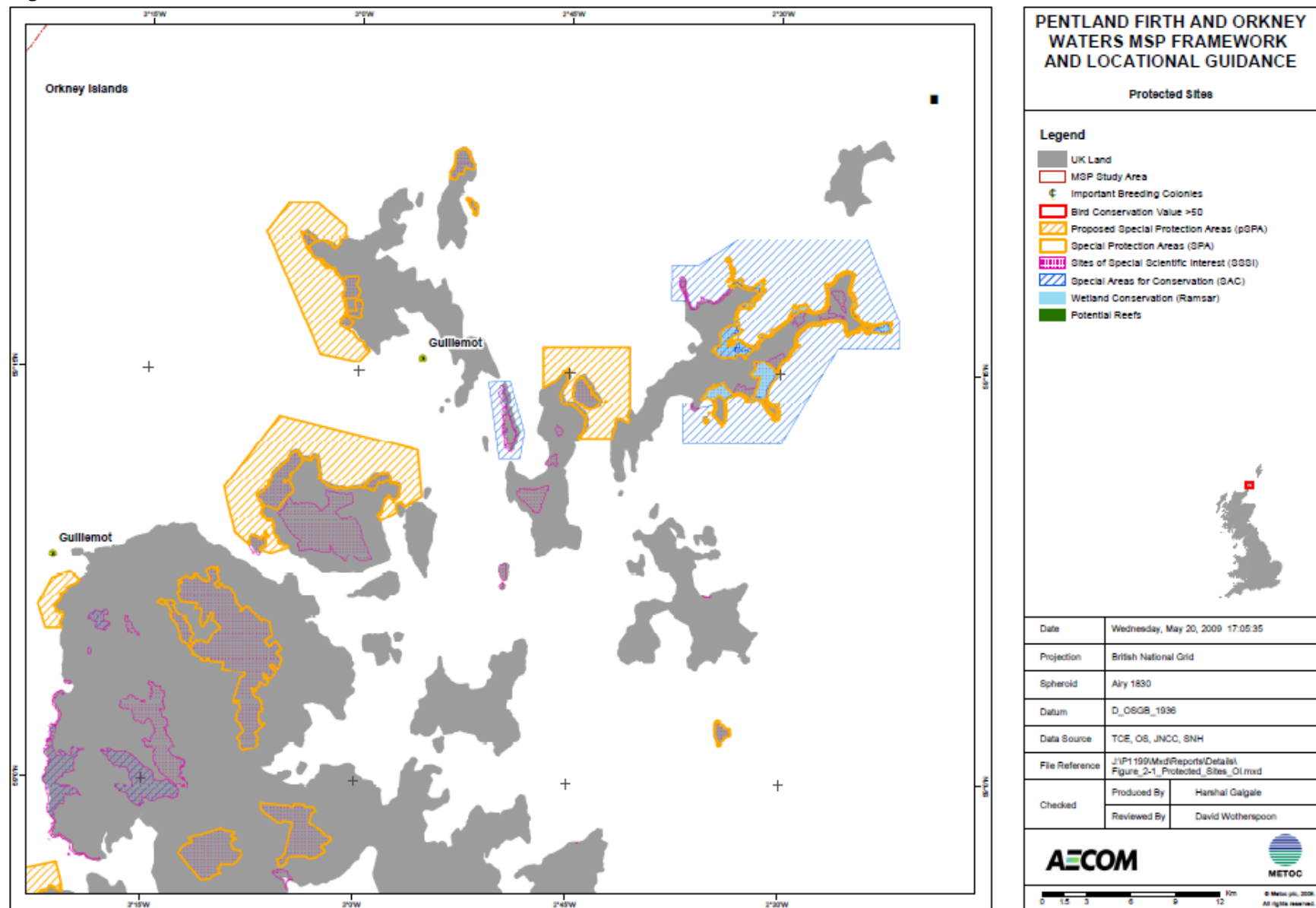
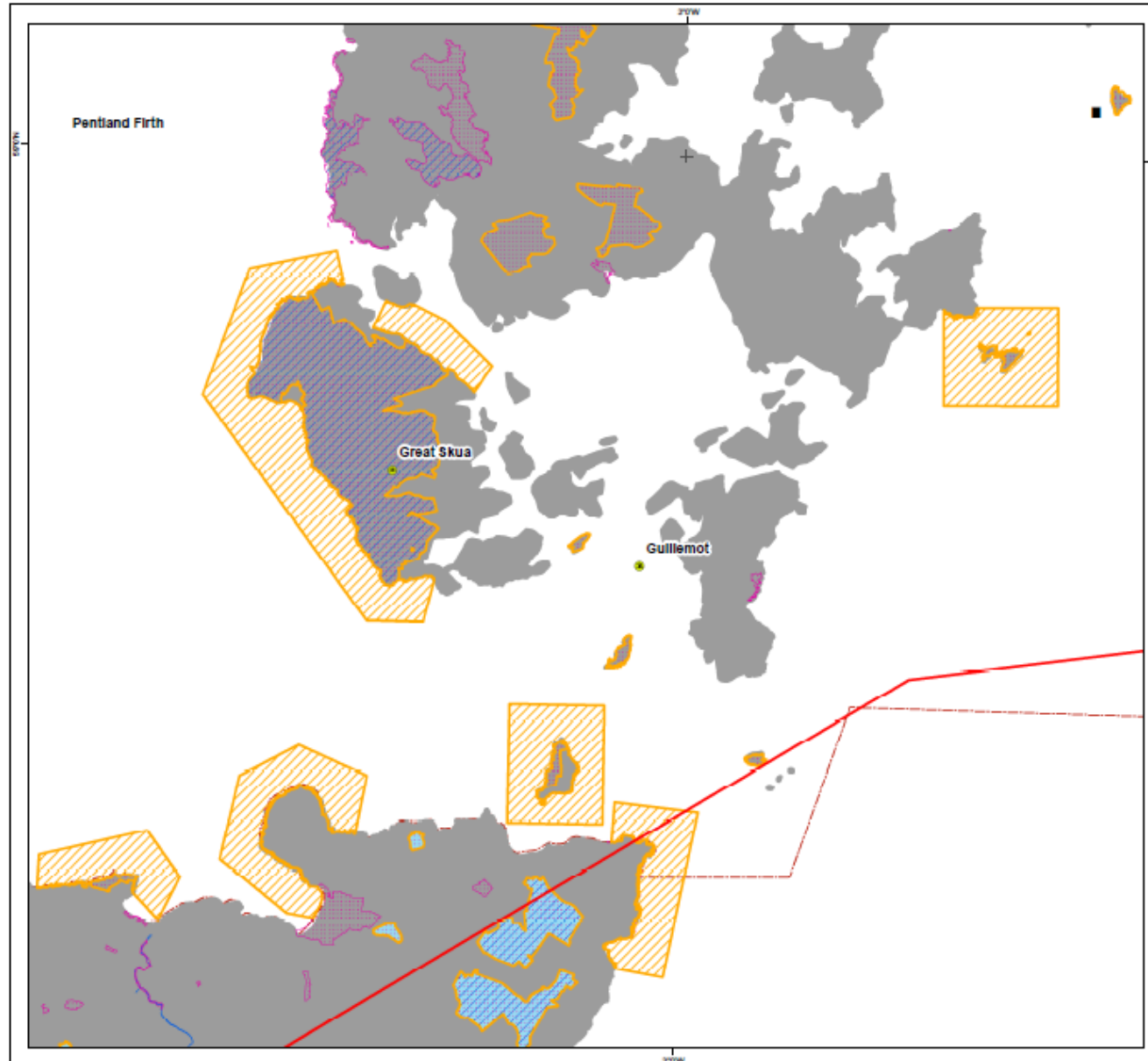


Figure A7b: Protected Sites



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Protected Sites

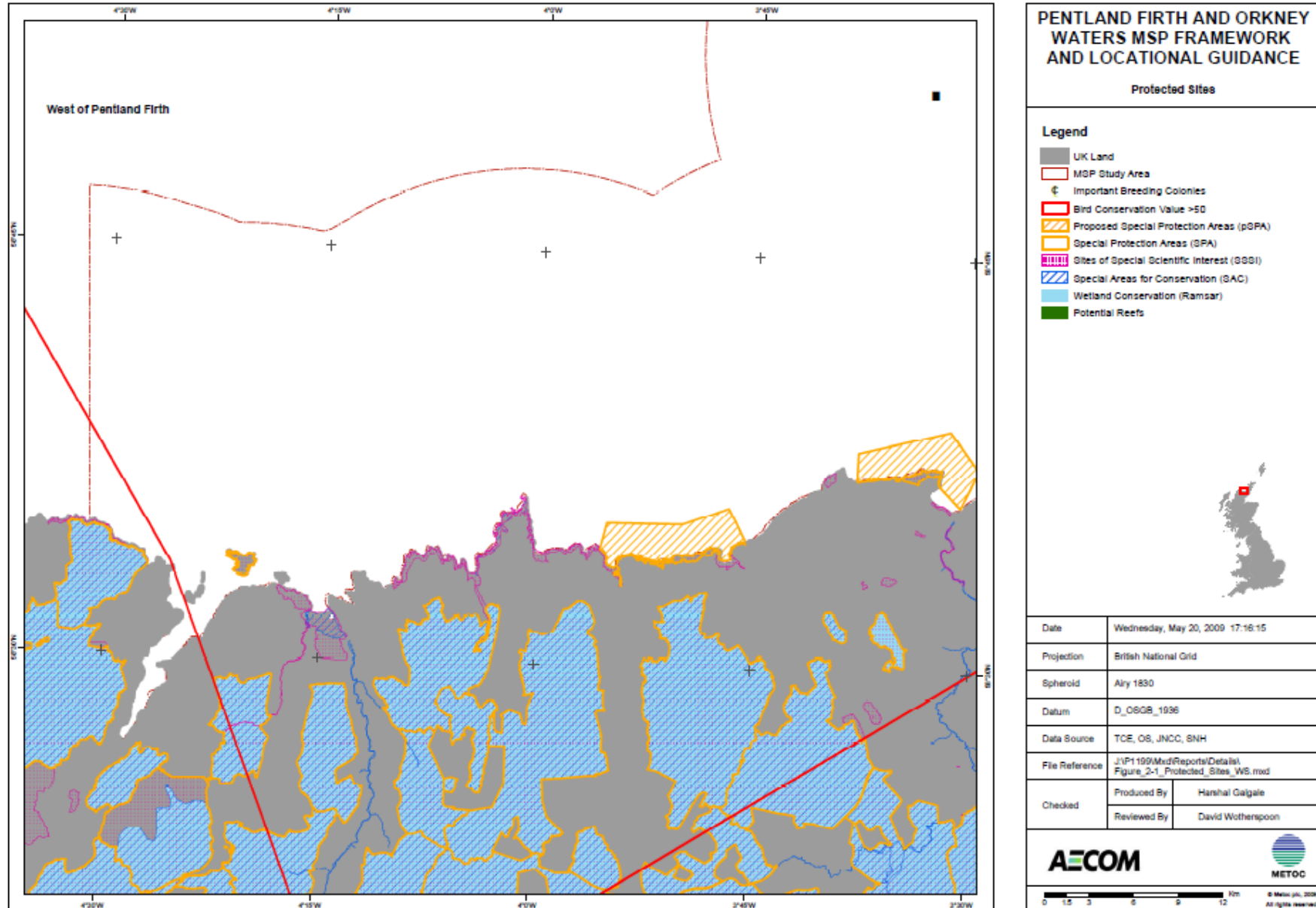
Legend

- UK Land
- MSP Study Area
- + Important Breeding Colonies
- Bird Conservation Value >50
- Proposed Special Protection Areas (pSPA)
- Special Protection Areas (SPA)
- Sites of Special Scientific Interest (SSSI)
- Special Areas for Conservation (SAC)
- Wetland Conservation (Ramsar)
- Potential Reefs

Date	Wednesday, May 20, 2009 17:17:41
Projection	British National Grid
Spheroid	Airy 1830
Datum	D_OSGB_1936
Data Source	TCE, OS, JNCC, SNH
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	Reviewed By: David Wotherspoon

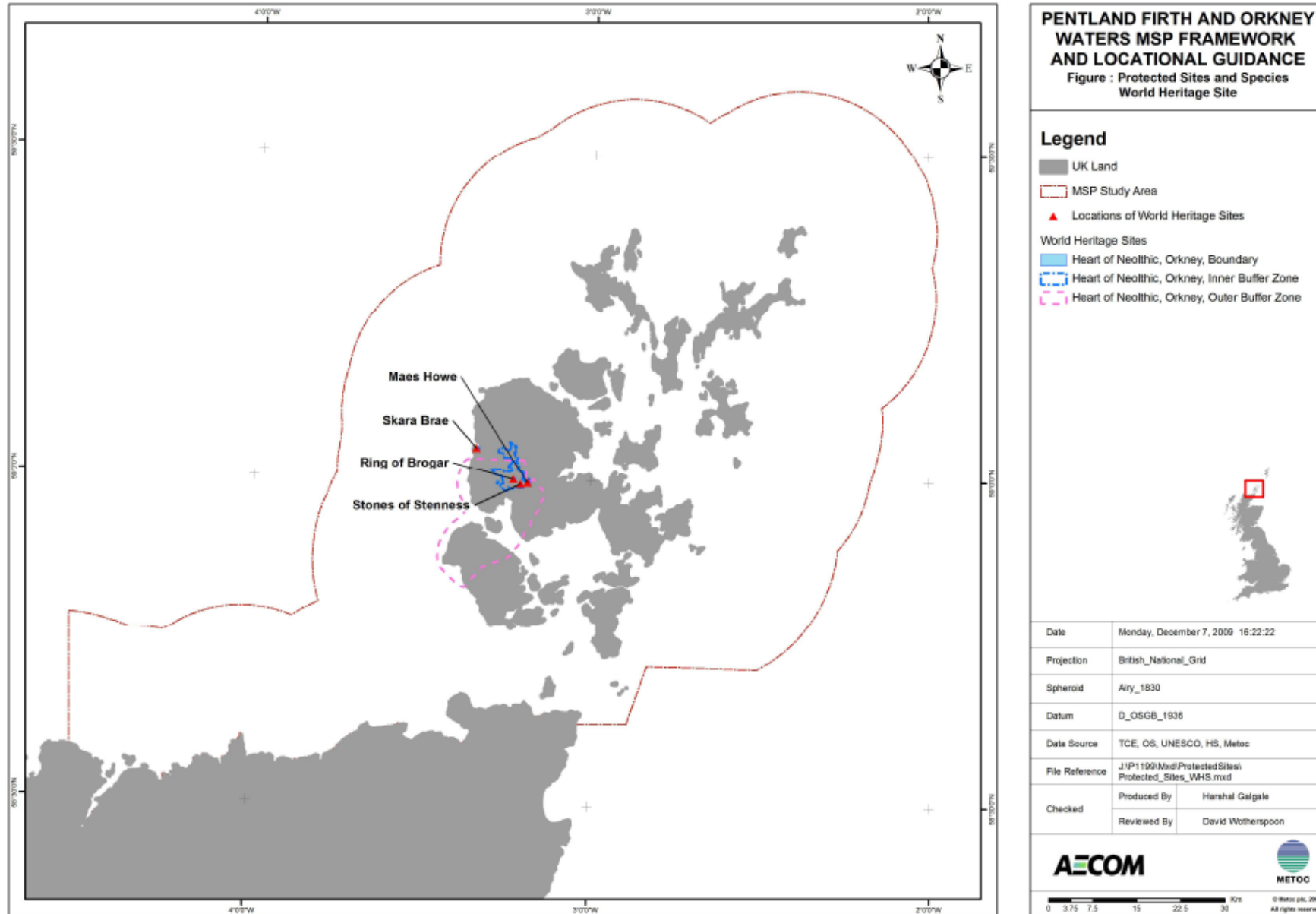
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Figure A7c: Protected Sites



APPENDIX A: BASELINE FIGURES: HERITAGE

Figure A8: Protected Sites and Species, World Heritage Sites



WHS Data sourced from Historic Scotland, PSI Licence C2009002893

Figure A9: Protected Sites and Species, Scheduled Ancient Monuments

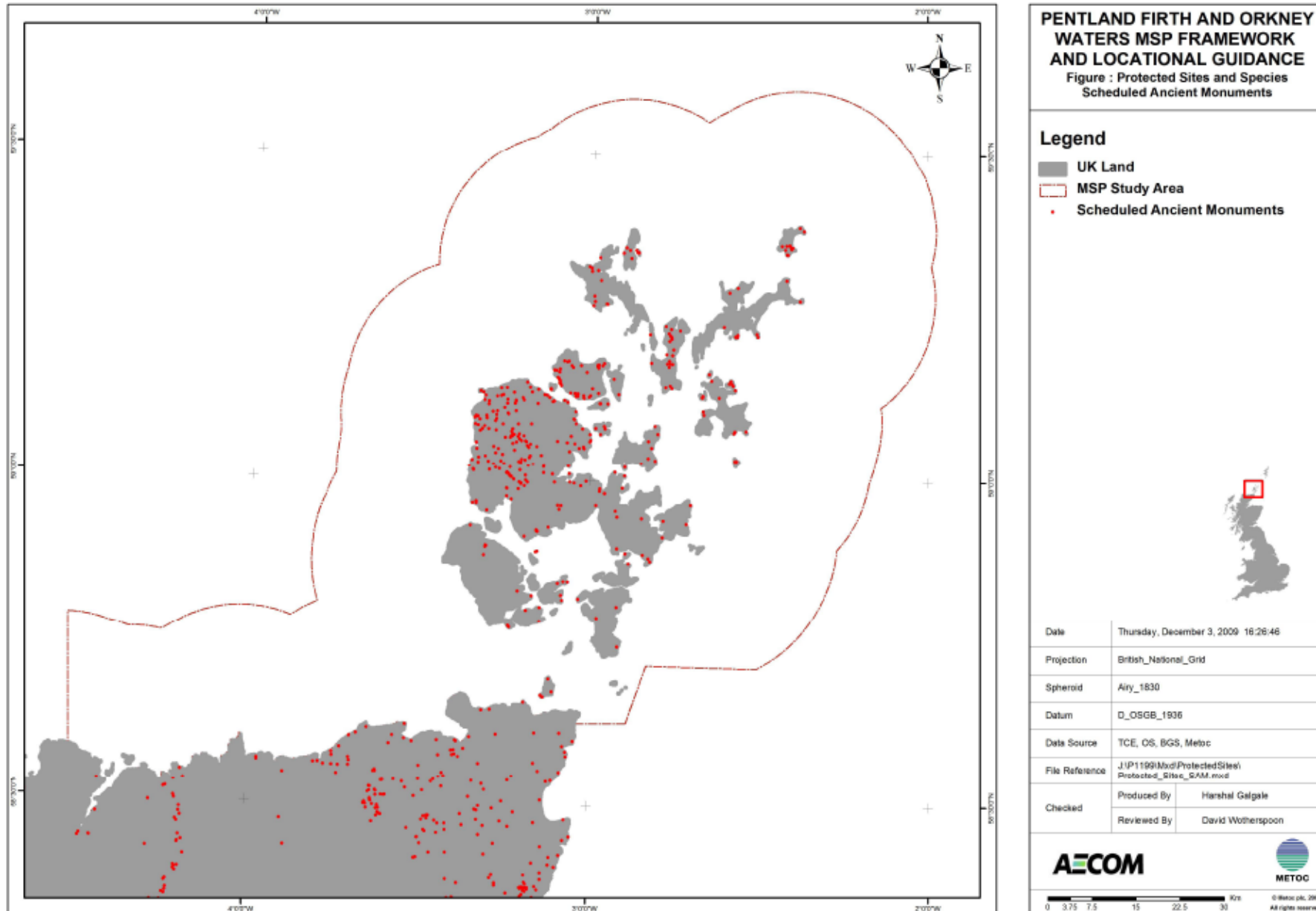
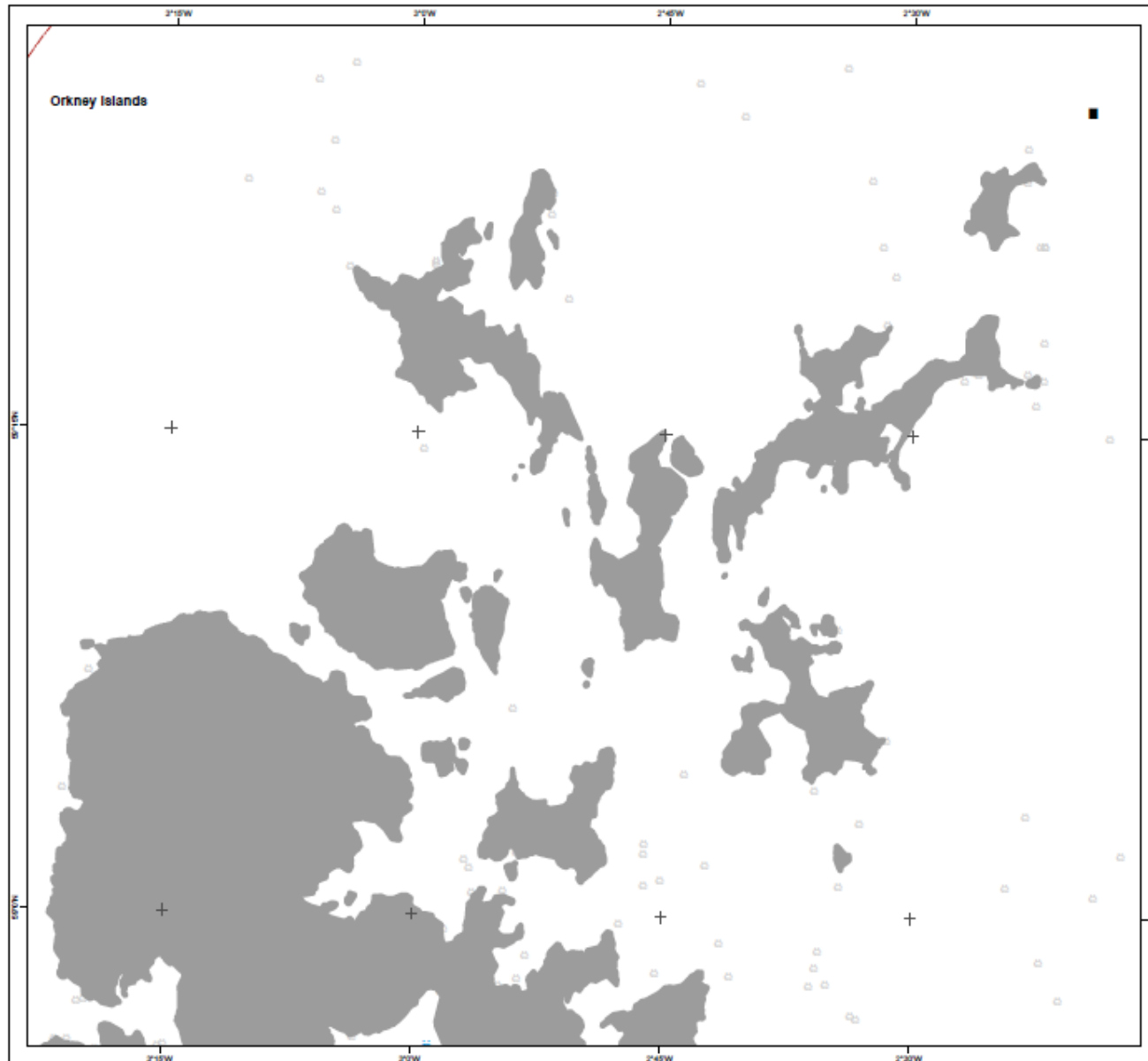


Figure A10a: Wreck Sites



**PENTLAND FIRTH AND ORKNEY
WATERS MSP FRAMEWORK
AND LOCATIONAL GUIDANCE**

Wreck Sites

Legend

- UK Land
- MSP Study Area
- Marine Scheduled Ancient Monument
- Protected under Military Remains Act
- Protected under Protection of Wrecks Act
- Live wreck



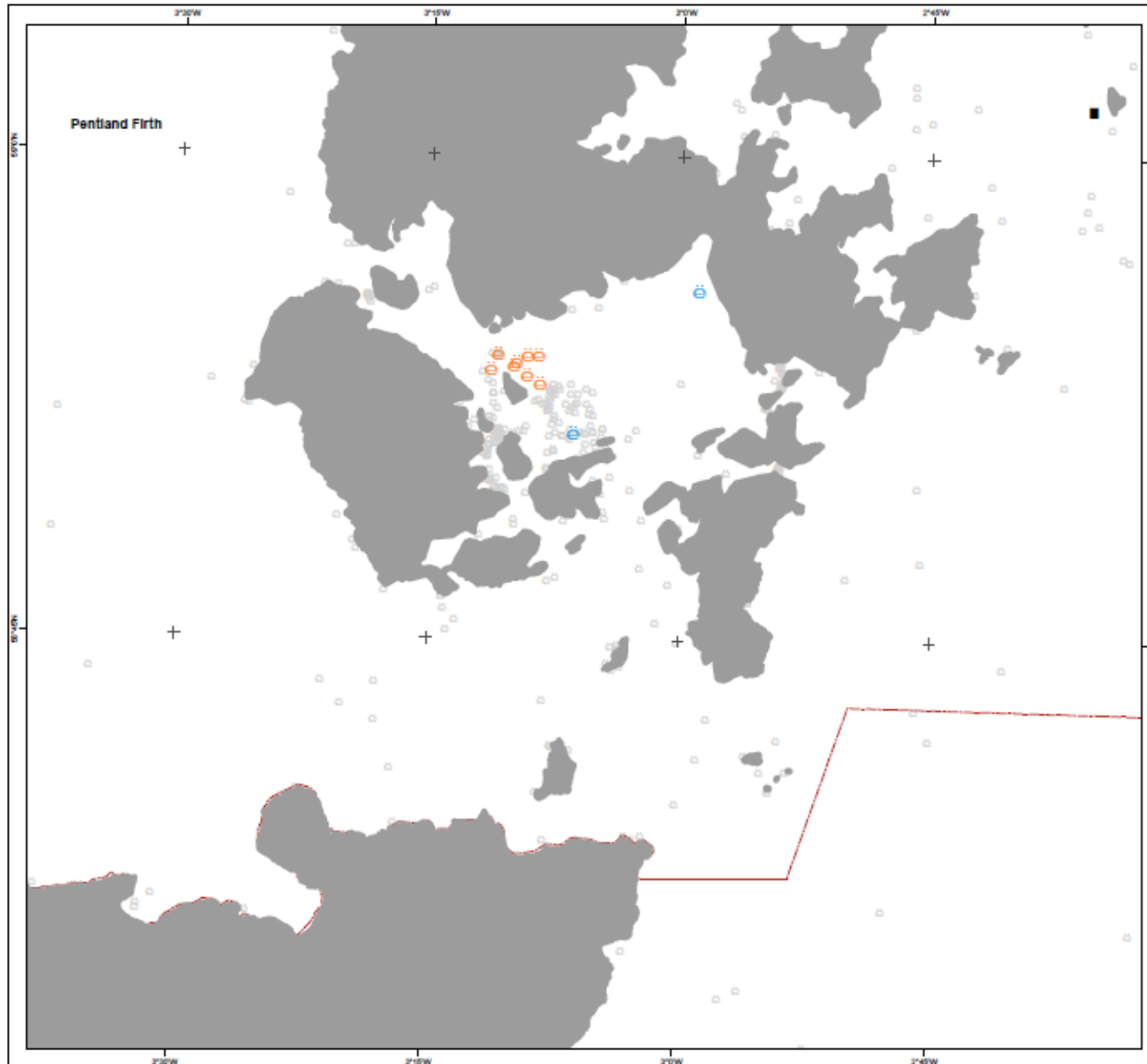
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Checked	Produced By	Harshal Galgale
	Reviewed By	David Wotherspoon







Figure A10b: Wreck Sites



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Wreck Sites

Legend

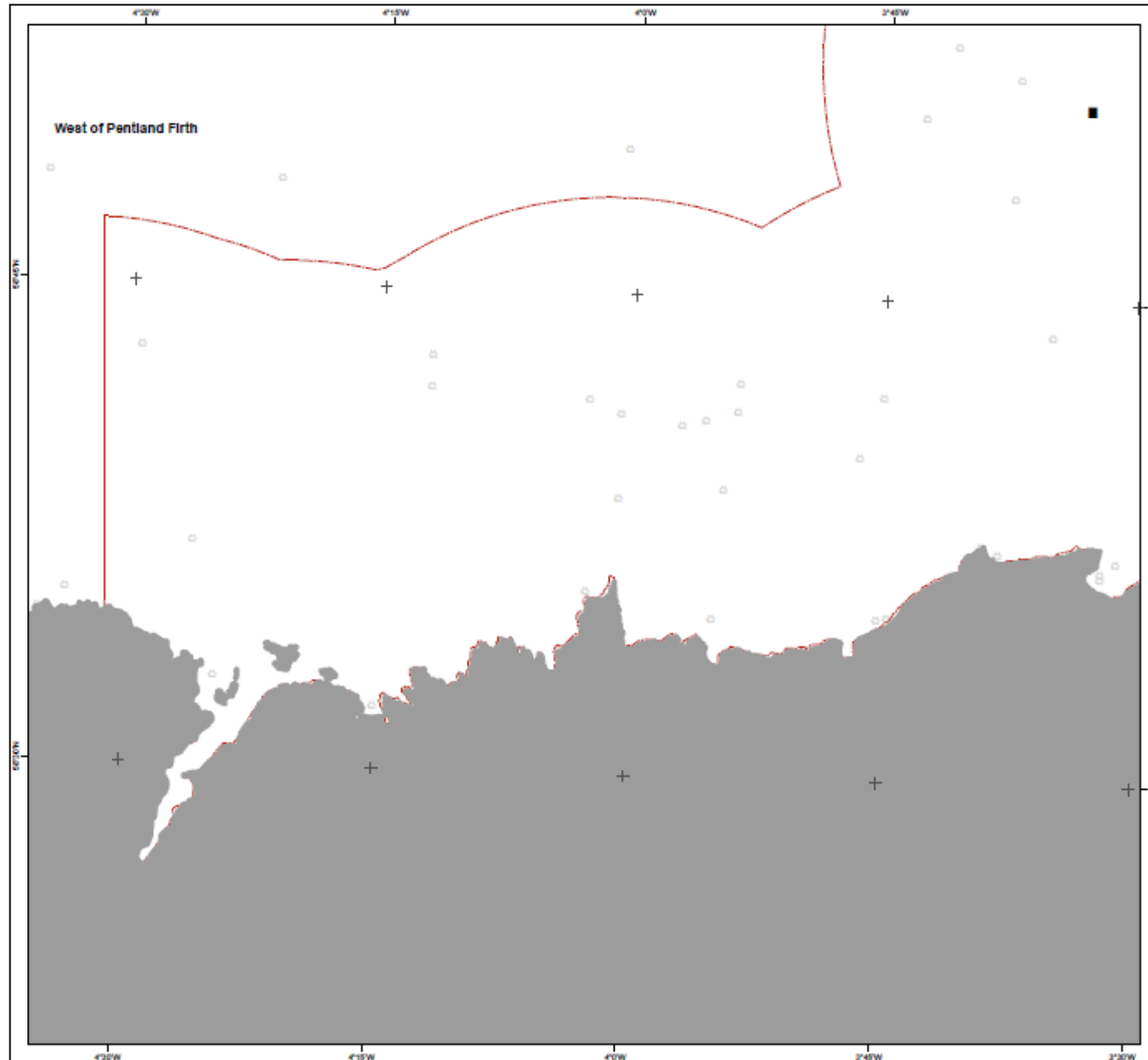
- UK Land
- MSP Study Area
- Marine Scheduled Ancient Monument
- Protected under Military Remains Act
- Protected under Protection of Wrecks Act
- Live wreck

Date	Wednesday, May 20, 2009 17:50:06	
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File Reference	J:\P1199\Med\Reports\Details\Figure_2-17_Cultural_Heritage_FF.mxd	
Checked	Produced By	Hanshal Galgale
	Reviewed By	David Wotherspoon

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Figure A10c: Wreck Sites



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCALITIONAL GUIDANCE

Wreck Sites

Legend

- UK Land
- ▭ MSP Study Area
- ⊕ Marine Scheduled Ancient Monument
- ⊕ Protected under Military Remains Act
- ⊕ Protected under Protection of Wrecks Act
- Live wreck

Date	Wednesday, May 20, 2009 17:50:24	
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File Reference	J:\P1199\Med\Reports\Details\Figure_2-17_Cultural_Heritage_WS.mxd	
Checked	Produced By	Harshal Galgale
	Reviewed By	David Wutherspoon

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0 1.5 3 6 9 12 Km © Metac 2008 All rights reserved.

APPENDIX A: BASELINE FIGURES: BATHYMETRY

Figure A11a: Bathymetry (Rasters)

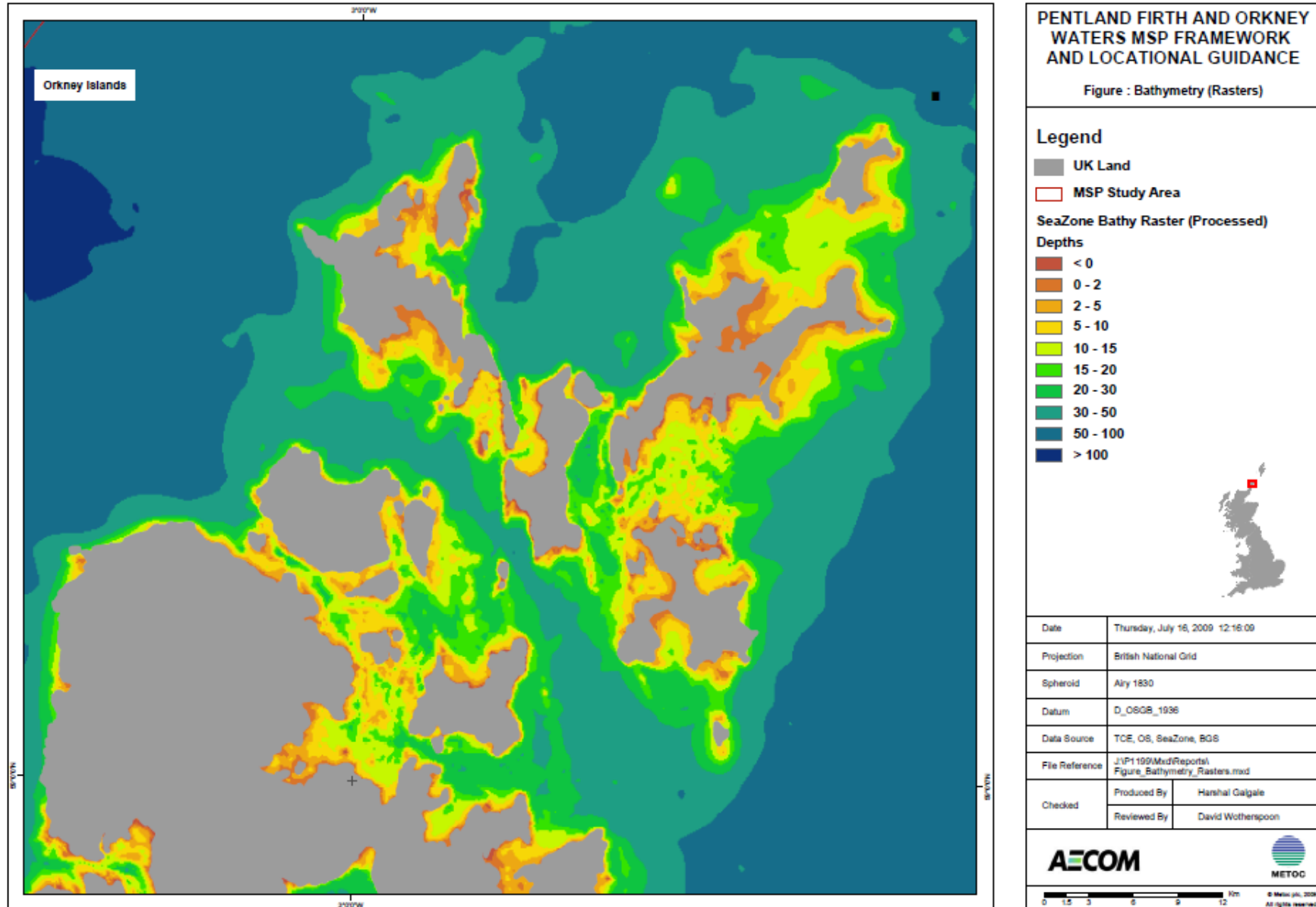
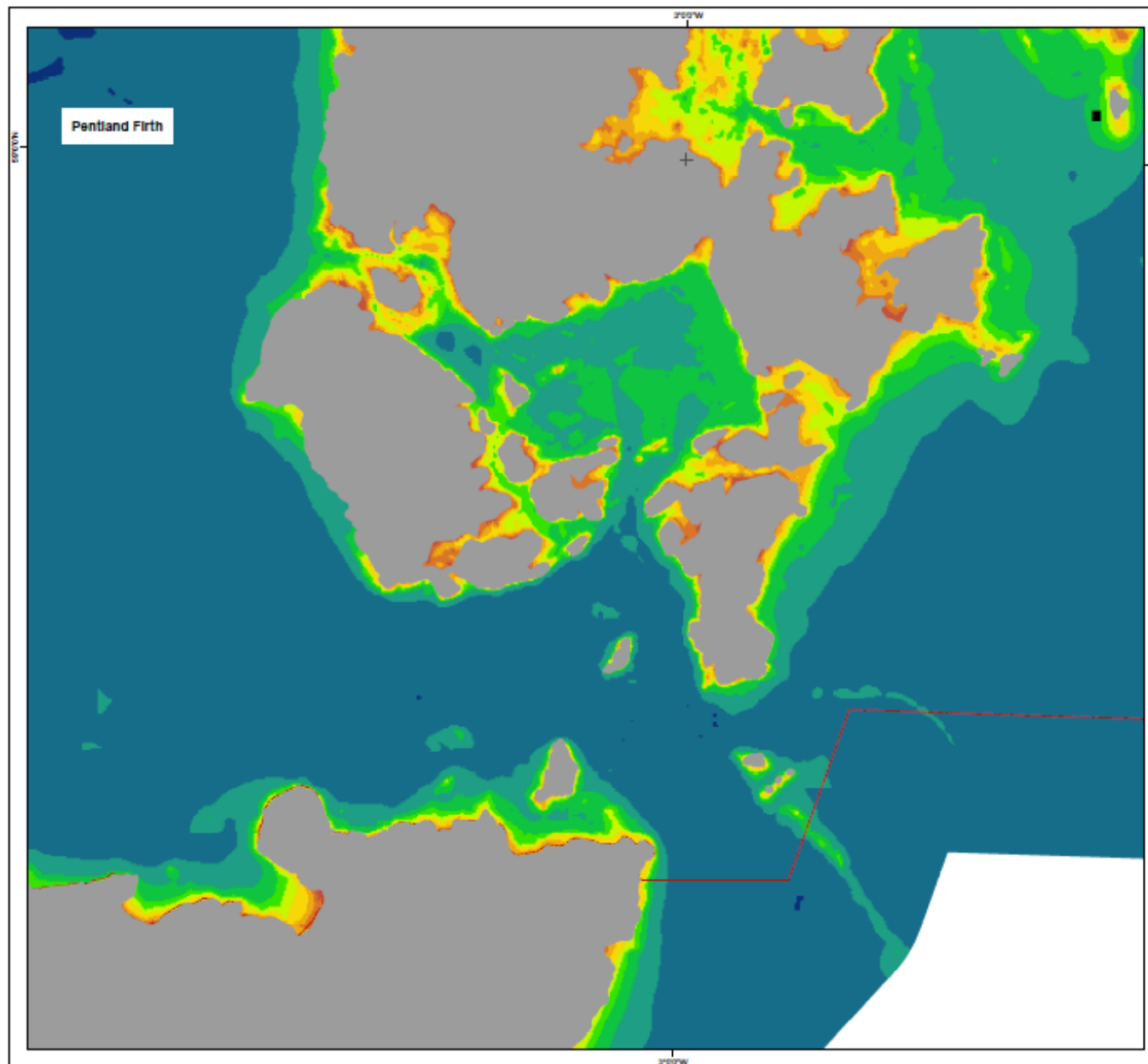


Figure A11b: Bathymetry (Rasters)



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCALATIONAL GUIDANCE

Figure : Bathymetry (Rasters)

Legend


- UK Land
- MSP Study Area

SeaZone Bathy Raster (Processed)

Depths

- < 0
- 0 - 2
- 2 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 30
- 30 - 50
- 50 - 100
- > 100

Date	Thursday, July 16, 2009 12:16:09	
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Datum	D_OSGE_1936	
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Checked	Produced By	Harshal Gaigale
	Reviewed By	David Wotherspoon

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Figure A11c: Bathymetry (Rasters)

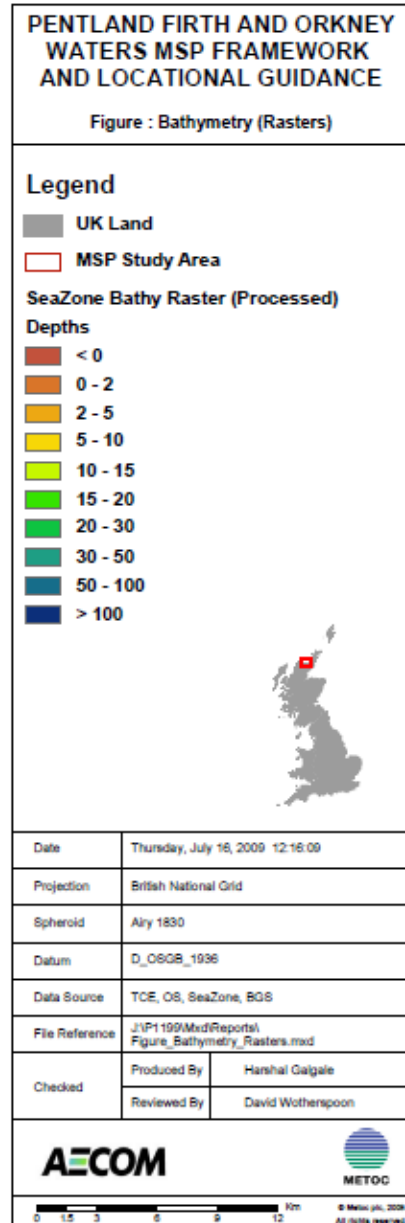
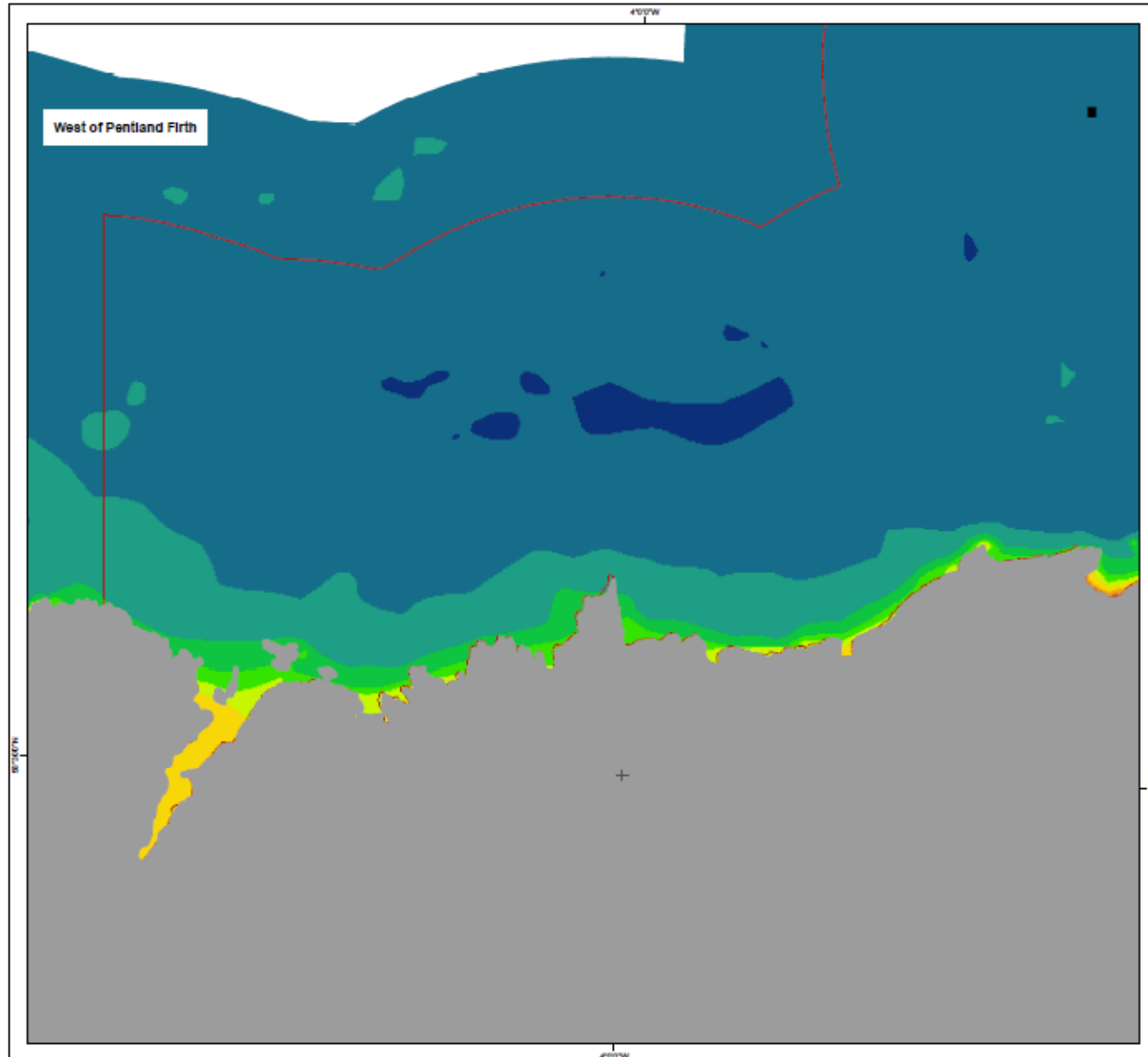
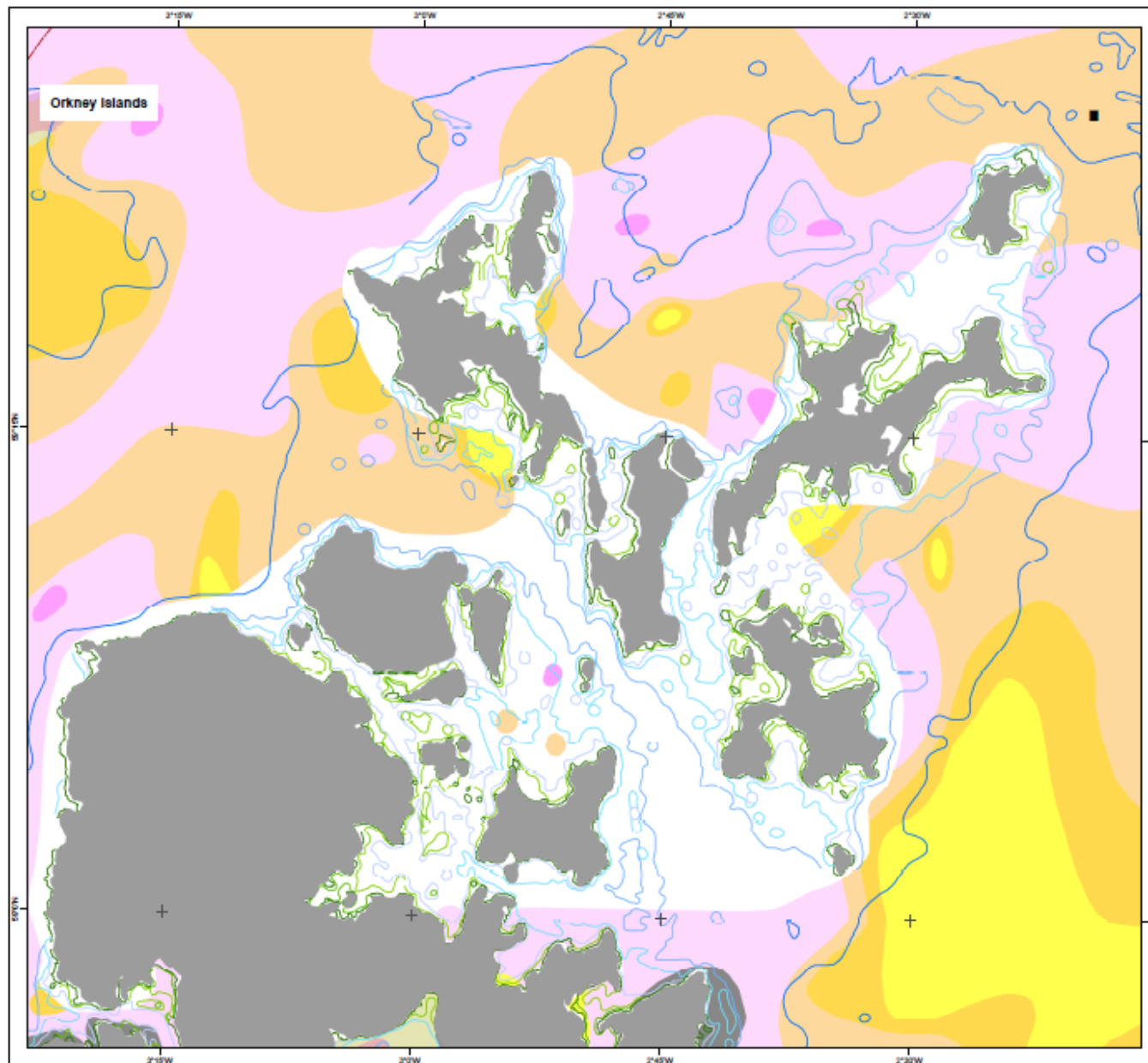


Figure A12a: Bathymetry and Seabed Surface Geology



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Bathymetry & Seabed surface geology

Legend

- | | |
|--|--|
| <ul style="list-style-type: none"> UK Land MSP Study Area Mussel deposit Gravelly muddy sand Gravel, mud and silt Gravel Gravelly mud Gravelly sand Muddy gravel Muddy sandy gravel Mud Muddy sand Sandy gravel Sandy mud Slightly gravelly muddy sand Slightly gravelly mud Slightly gravelly sand Slightly gravelly sandy mud Sand Diamicton Rock or Diamicton Rock and sediment Undifferentiated solid rock Clay and sand | <ul style="list-style-type: none"> Bathymetry (m) 0 2 5 10 20 30 50 100 200 300 |
|--|--|



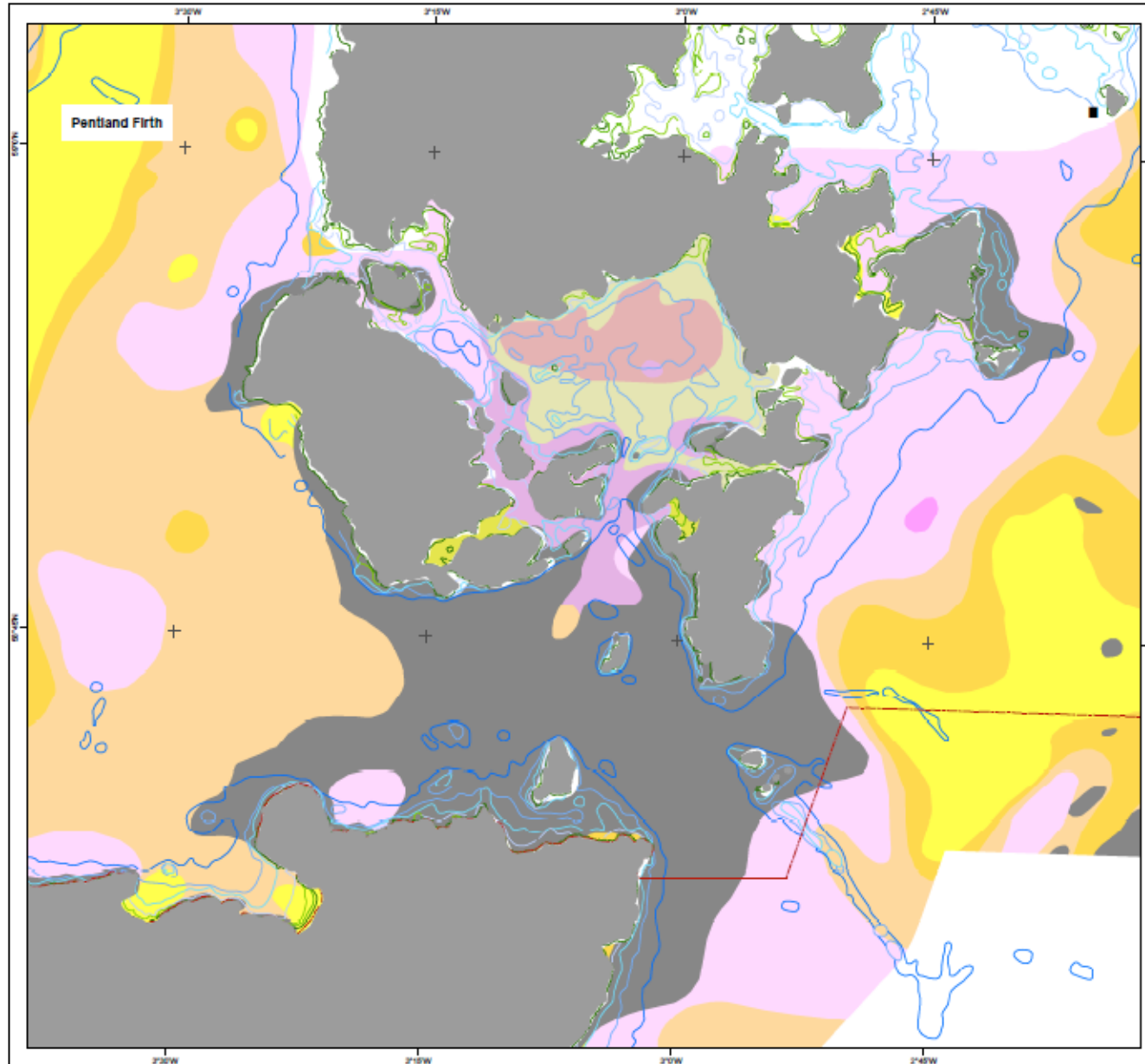
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File Reference	J:\P1 199\Mud\Reports\Details\ Figure_2-15_Seabed_Sediments_Bathymetry_OI	
Checked	Produced By	Harshal Galgale
	Reviewed By	David Wotherspoon







Figure A12b: Bathymetry and Seabed Surface Geology



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Bathymetry & Seabed surface geology

Legend

- | | |
|--|---|
| <ul style="list-style-type: none"> UK Land MSP Study Area Mussel deposit Gravelly muddy sand Gravel, mud and silt Gravel Gravelly mud Gravelly sand Muddy gravel Muddy sandy gravel Mud Muddy sand Sandy gravel Sandy mud Slightly gravelly muddy sand Slightly gravelly mud Slightly gravelly sand Slightly gravelly sandy mud Sand Diamicton Rock or Diamicton Rock and sediment Undifferentiated solid rock Clay and sand | <p>Bathymetry (m)</p> <ul style="list-style-type: none"> 0 2 5 10 20 30 50 100 200 300 |
|--|---|



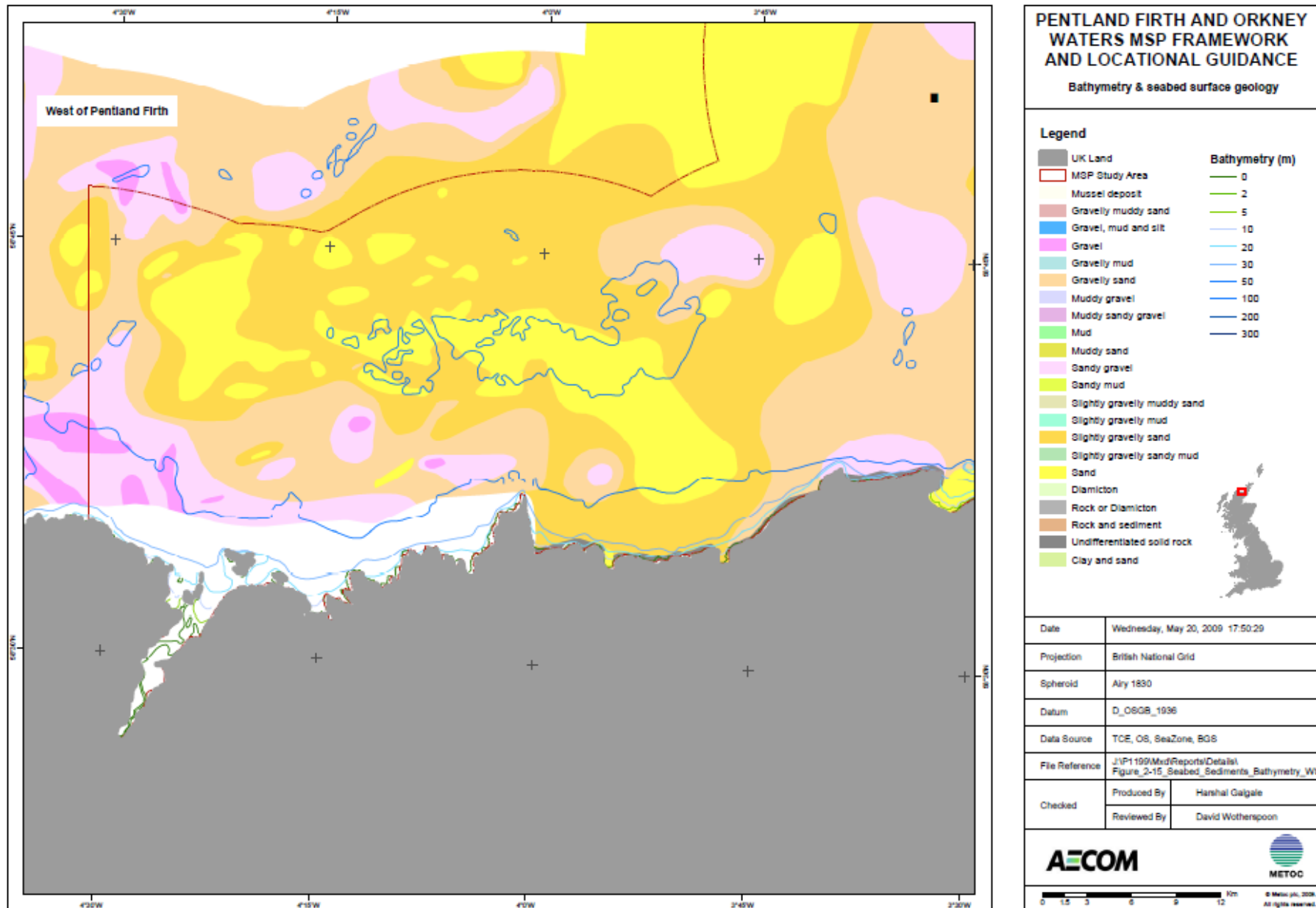
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Checked	Produced By	Harshal Galgale
	Reviewed By	David Wotherspoon

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Figure A12c: Bathymetry and Seabed Surface Geology



APPENDIX A: BASELINE FIGURES: MARICULTURE

Figure A13a: Mariculture

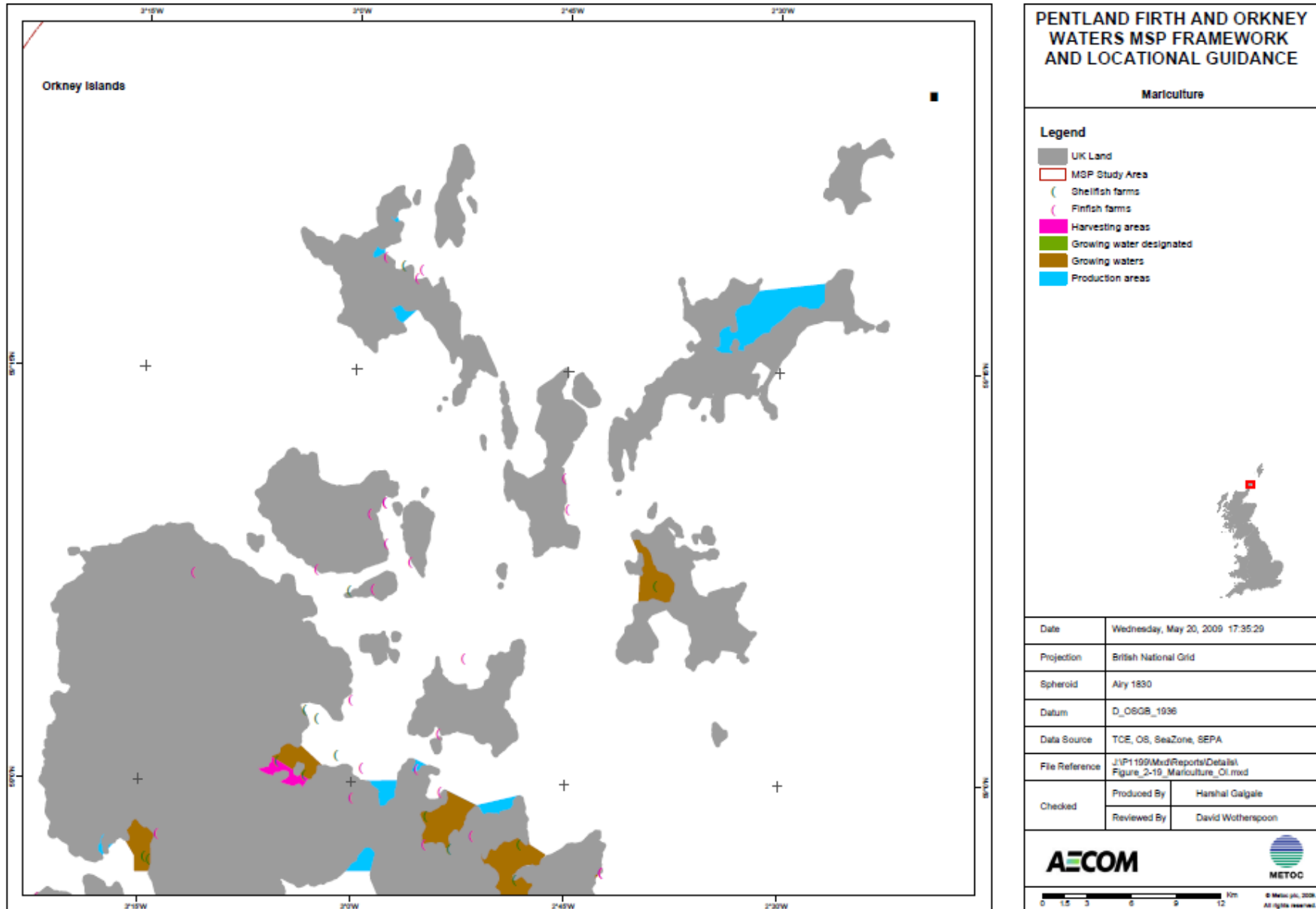
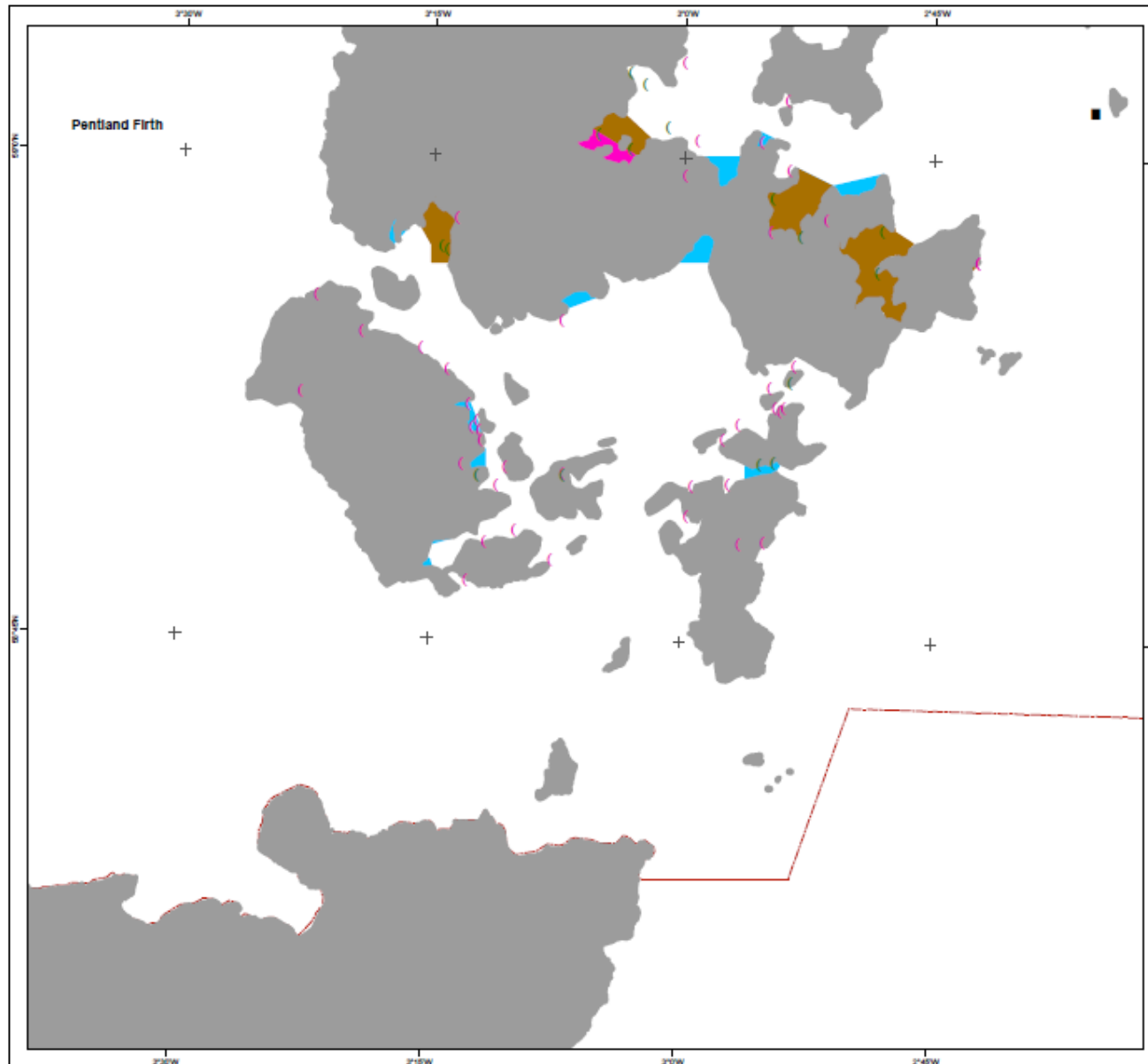


Figure A13b: Mariculture



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Mariculture

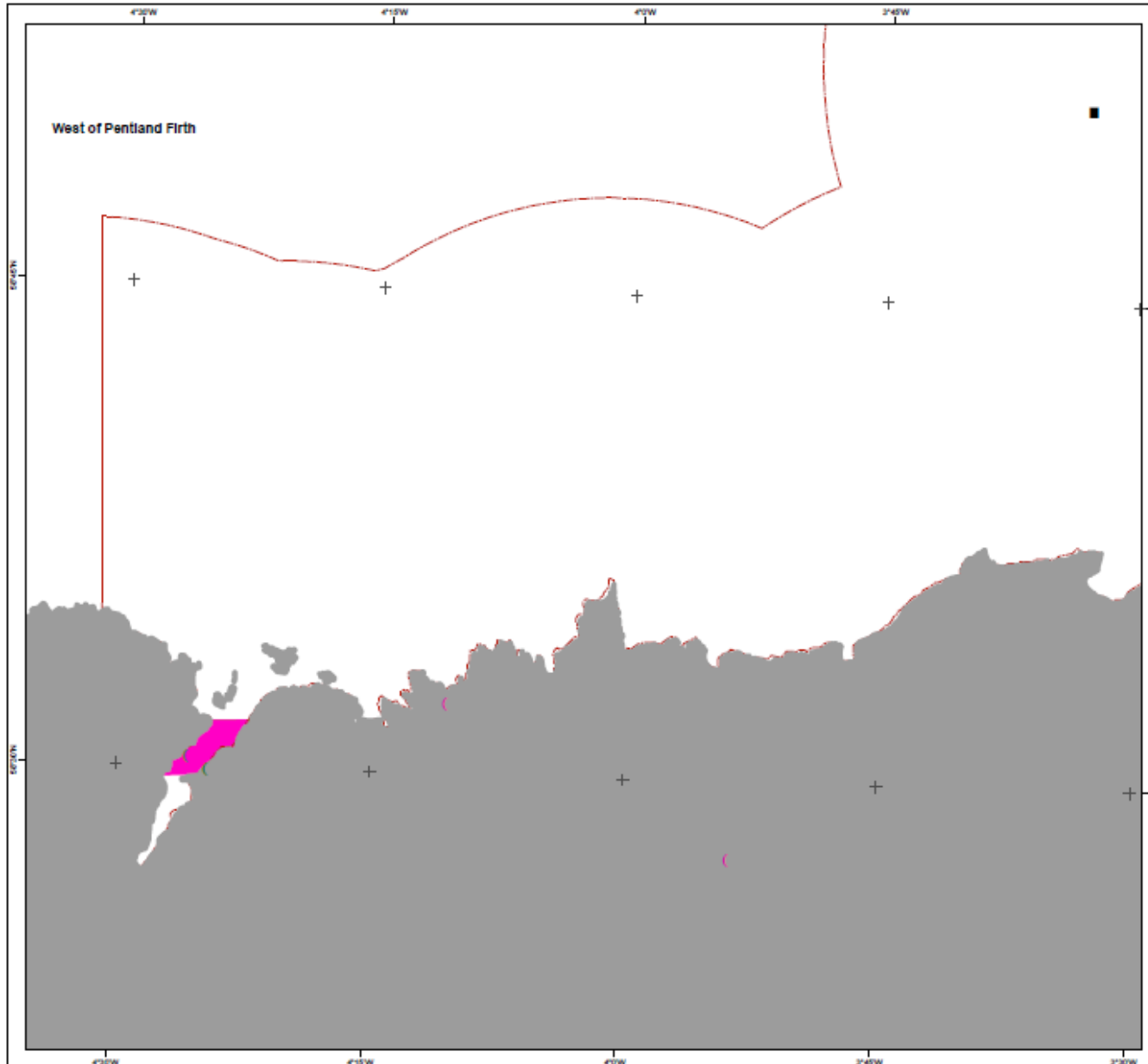
Legend

- UK Land
- MSP Study Area
- Shellfish farms
- Finfish farms
- Harvesting areas
- Growing water designated
- Growing waters
- Production areas

Date	Wednesday, May 20, 2009 17:33:55	
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Spheroid	Airy 1830	
Datum	D_OSGB_1936	
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File Reference	J:\P1199\Mxd\Reports\Details\ Figure_2-19_Mariculture_FF.mxd	
Checked	Produced By	Hannah Gaigale
	Reviewed By	David Wotherspoon

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Figure A13c: Mariculture



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Mariculture

Legend

- UK Land
- MSP Study Area
- (Shellfish farms
- (Finfish farms
- Harvesting areas
- Growing water designated
- Growing waters
- Production areas

Date	Wednesday, May 20, 2009 17:34:15	
Projection	British National Grid	
Spheroid	Airy 1830	
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File Reference	J:\P1199\MedReports\Detail\Figure_2-19_Mariculture_WS.mxd	
Checked	Produced By	Harshal Galgale
	Reviewed By	David Wotherpoon

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0 1.5 3 6 12 Km © Metoc plc, 2008. All rights reserved.

APPENDIX A: BASELINE FIGURES: FISHING ACTIVITY

Figure A14a: Fishing Activity Map

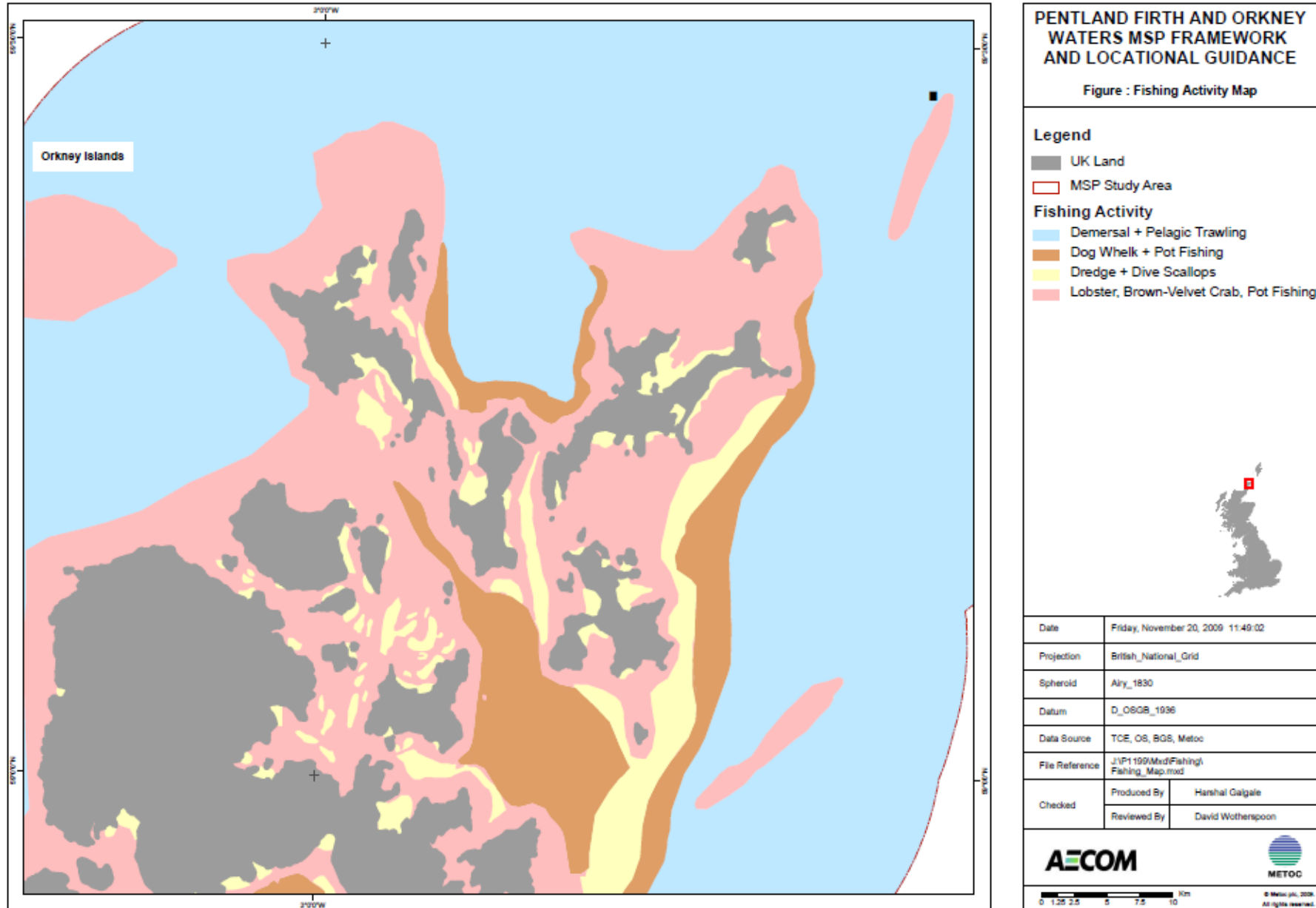
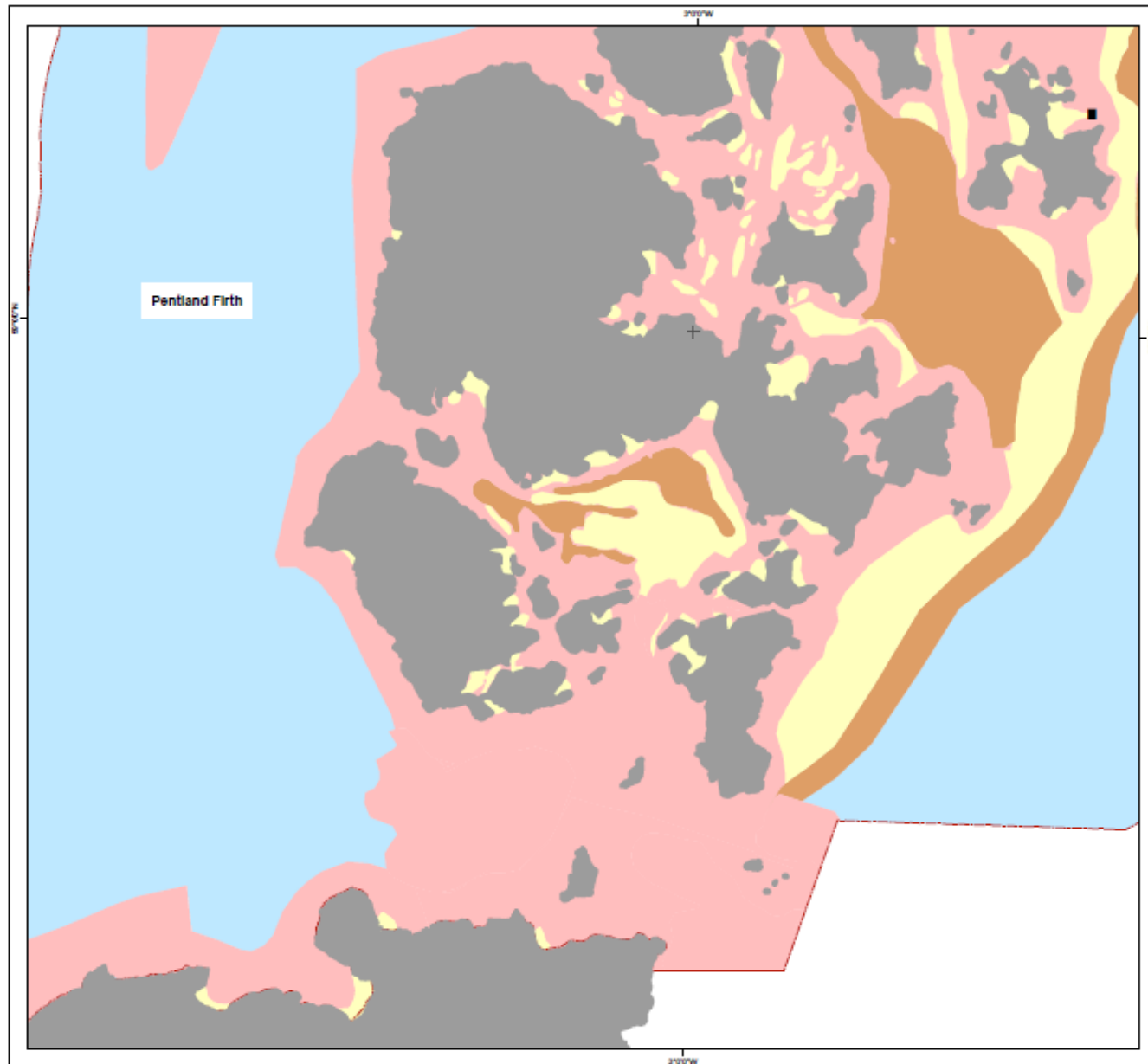


Figure A14b: Fishing Activity Map



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Figure : Fishing Activity Map

Legend

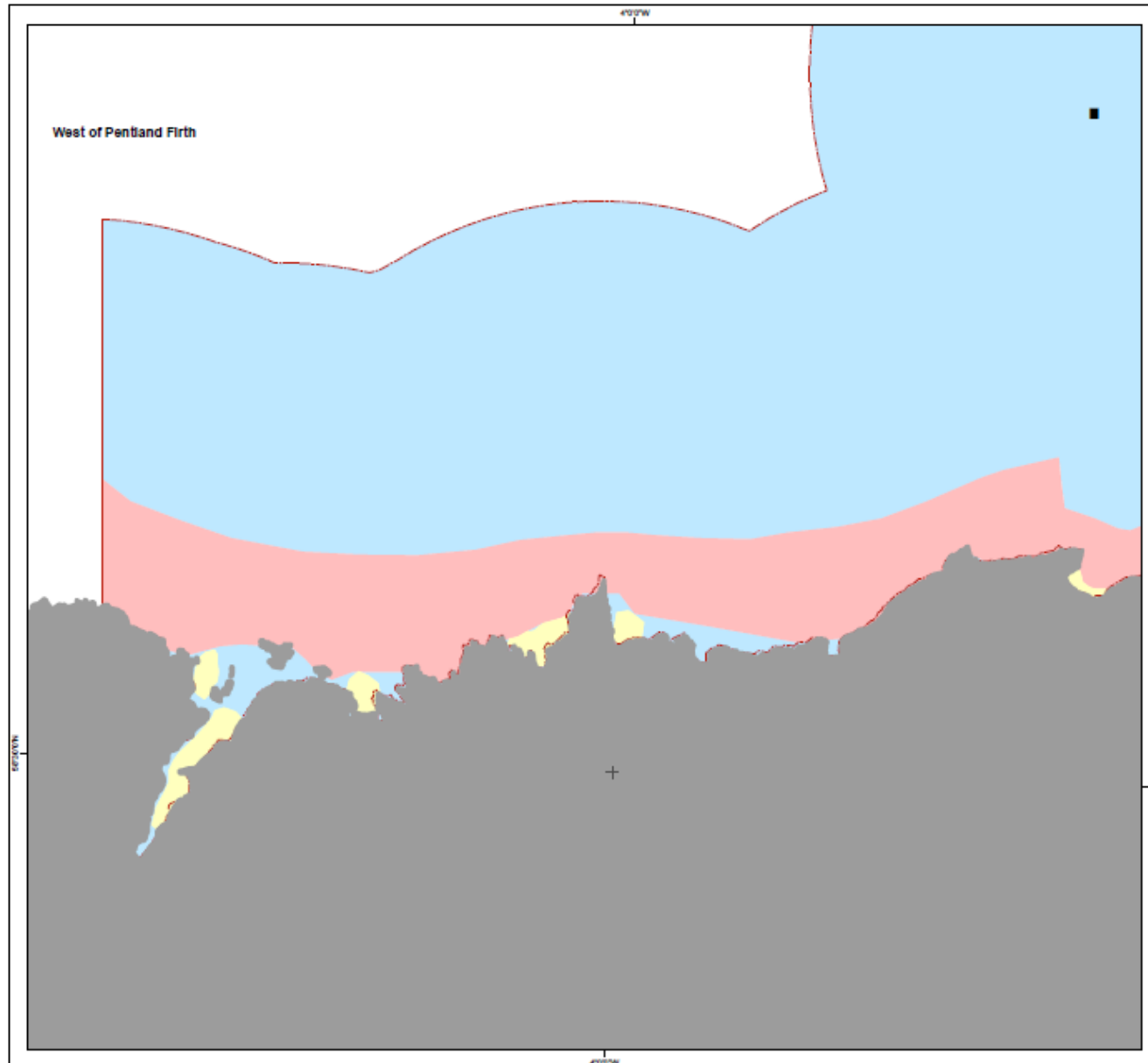
- UK Land
- MSP Study Area
- Fishing Activity**
 - Demersal + Pelagic Trawling
 - Dog Whelk + Pot Fishing
 - Dredge + Dive Scallops
 - Lobster, Brown-Velvet Crab, Pot Fishing

Date	Friday, November 20, 2009 11:49:02
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Spheroid	Airy_1830
Datum	D_OGGB_1936
Data Source	TCE, OS, BGS, Metoc
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Checked	Produced By: Harshal Galgale
	Reviewed By: David Wotherspoon

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0 1.25 2.5 5 7.5 10 Km
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Figure A14c: Fishing Activity Map



**PENTLAND FIRTH AND ORKNEY
WATERS MSP FRAMEWORK
AND LOCATIONAL GUIDANCE**

Figure : Fishing Activity Map

Legend

- UK Land
- MSP Study Area
- Fishing Activity**
- Demersal + Pelagic Trawling
- Dog Whelk + Pot Fishing
- Dredge + Dive Scallops
- Lobster, Brown-Velvet Crab, Pot Fishing



Date	Friday, November 20, 2009 11:49:02	
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Checked	Produced By	Hanshal Gaigale
	Reviewed By	David Wotherspoon



APPENDIX A: BASELINE FIGURES: OTHER SEABED USERS

Figure A15a: Other Seabed Users

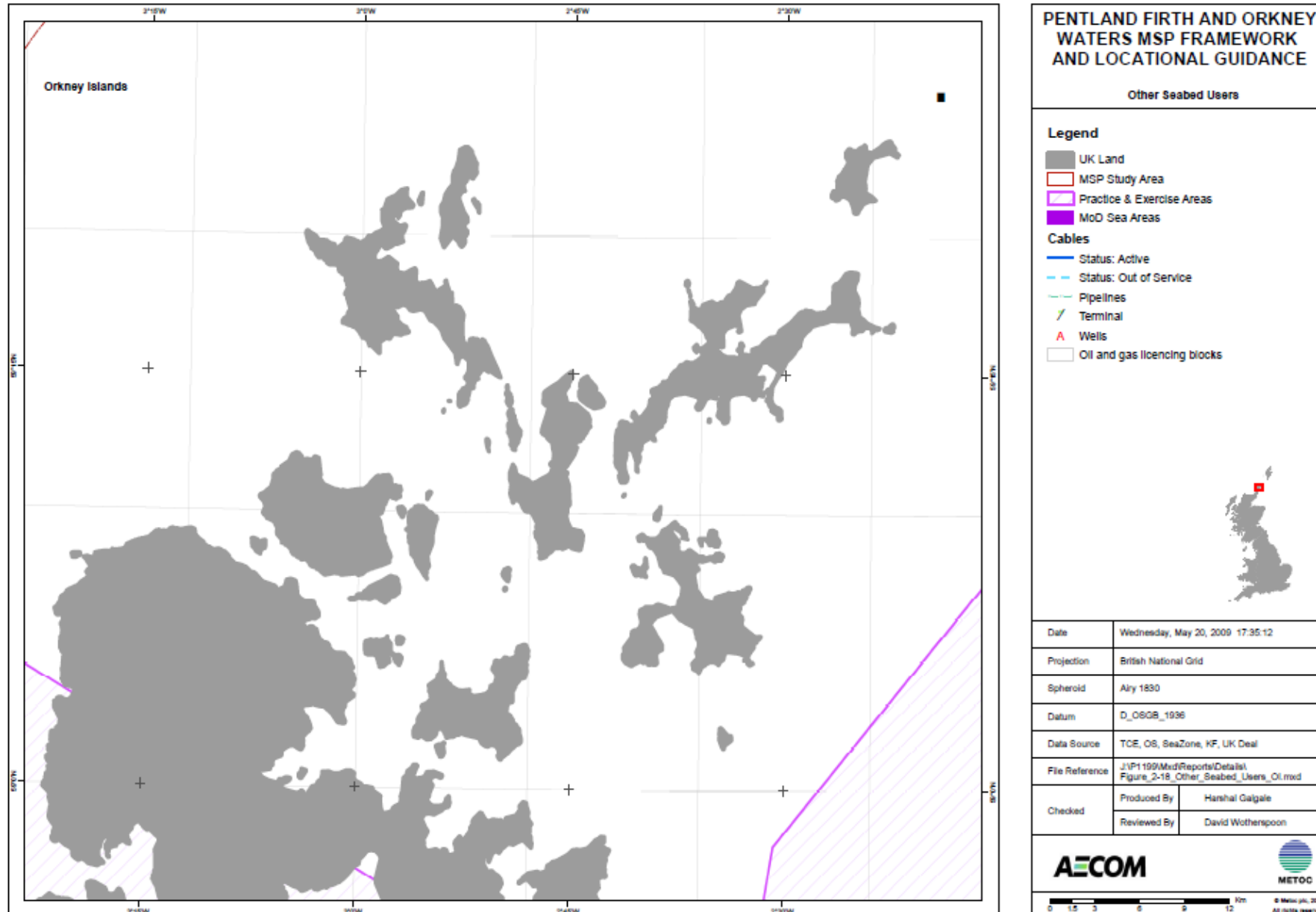
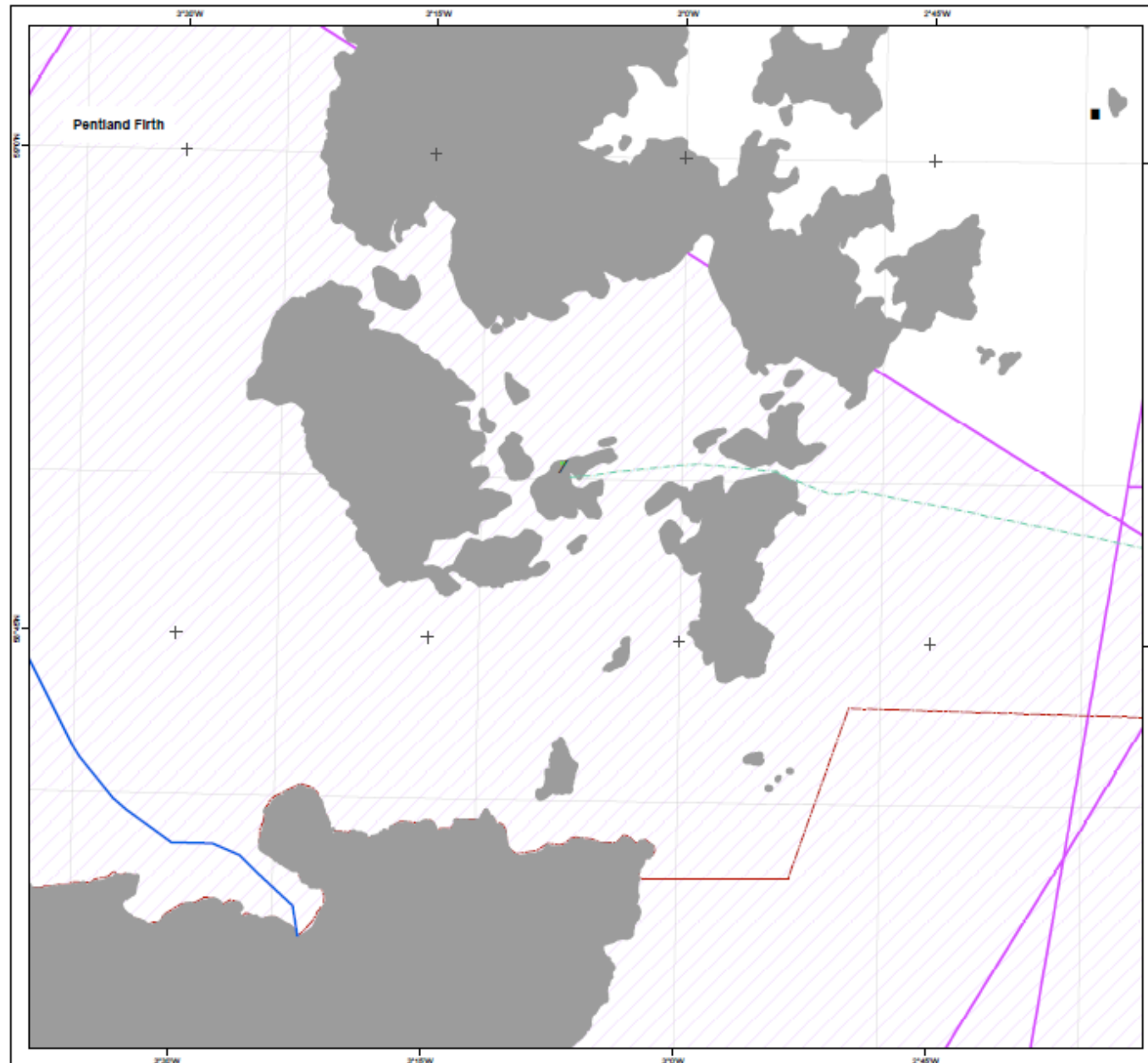


Figure A15b: Other Seabed Users



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Other Seabed Users

Legend

- UK Land
- MSP Study Area
- Practice & Exercise Areas
- MoD Sea Areas

Cables

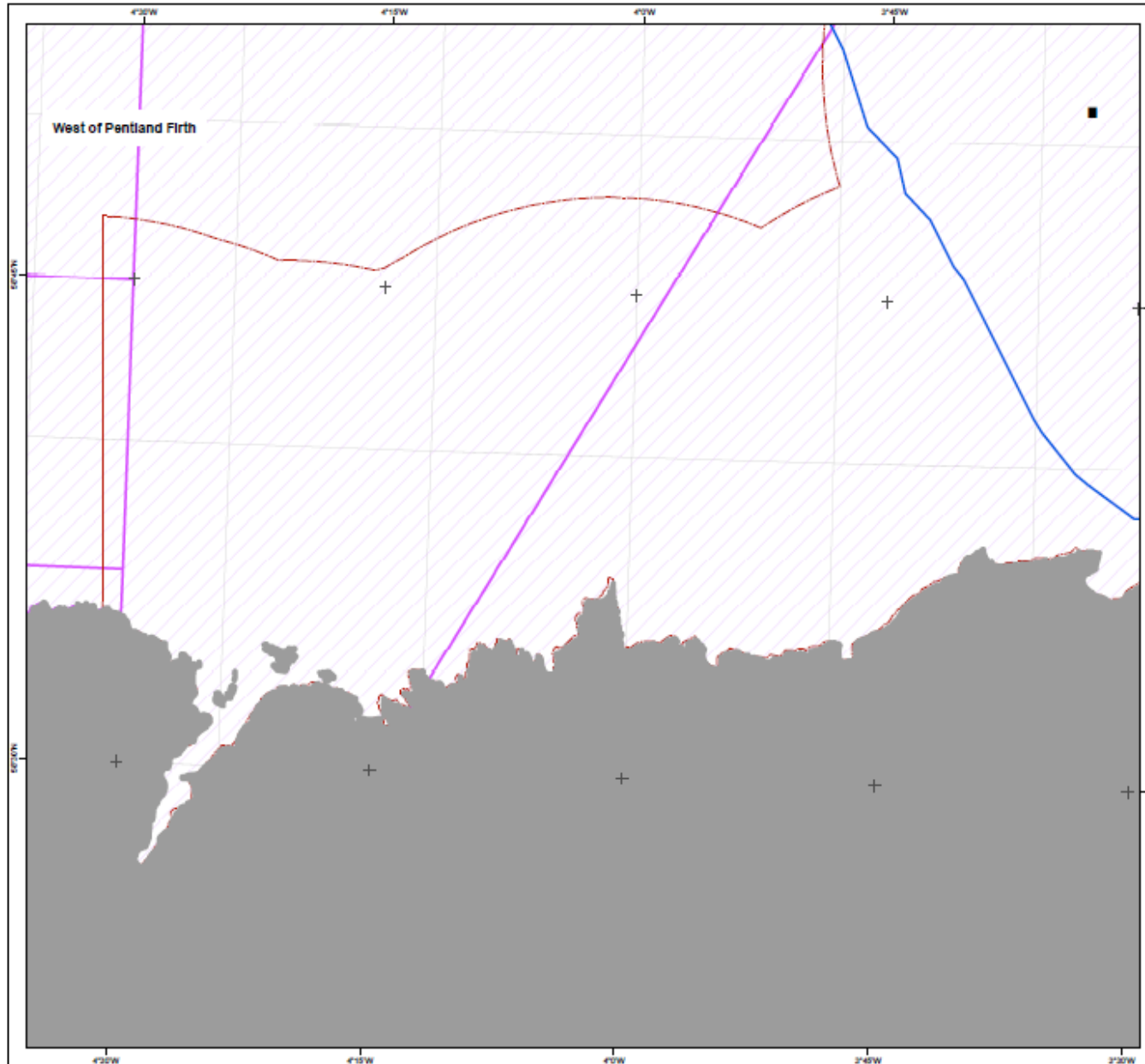
- Status: Active
- Status: Out of Service
- Pipelines
- Terminal
- Wells
- Oil and gas licencing blocks

Date	Wednesday, May 20, 2009 17:35:21	
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Spheroid	Airy 1830	
Datum	D_OSGB_1936	
Data Source	TCE, OS, SeaZone, KF, UK Deal	
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Checked	Produced By	Harshal Gargale
	Reviewed By	David Wotherspoon

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0 1.5 3 6 9 12 Km © Metos plc, 2009. All rights reserved.

Figure A15c: Other Seabed Users



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Other Seabed Users

Legend

- UK Land
- MSP Study Area
- Practice & Exercise Areas
- MoD Sea Areas
- Cables**
- Status: Active
- Status: Out of Service
- Pipelines
- Terminal
- Wells
- Oil and gas licencing blocks

Date	Wednesday, May 20, 2009 17:35:03	
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Checked	Produced By	Harshal Galgale
	Reviewed By	David Wotherspoon

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0 1.5 3 6 9 12 km © Metos plc, 2008. All rights reserved.

APPENDIX A: BASELINE FIGURES: RECREATION & TOURISM

Figure A16a: Recreation and Tourism – Sailing

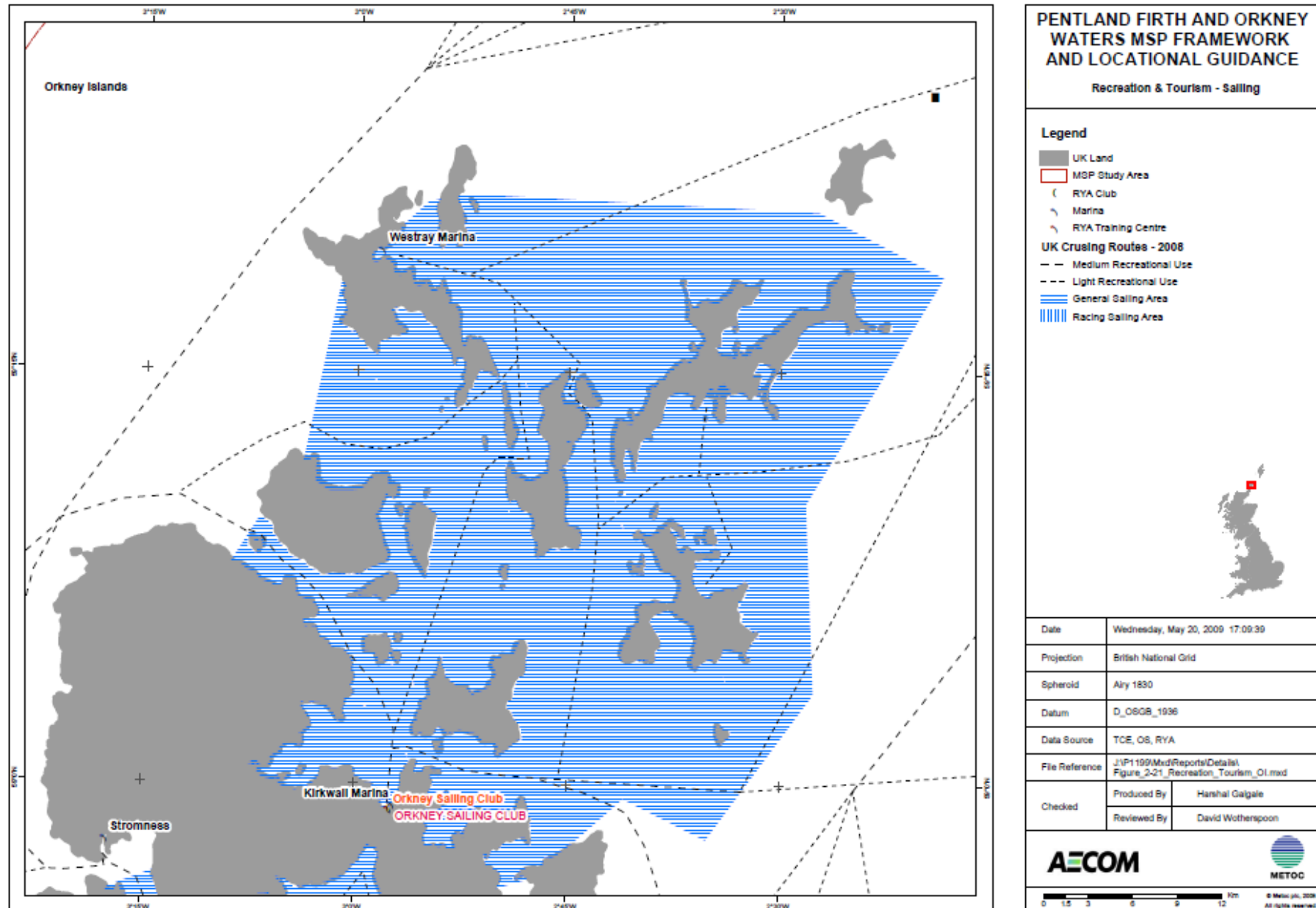
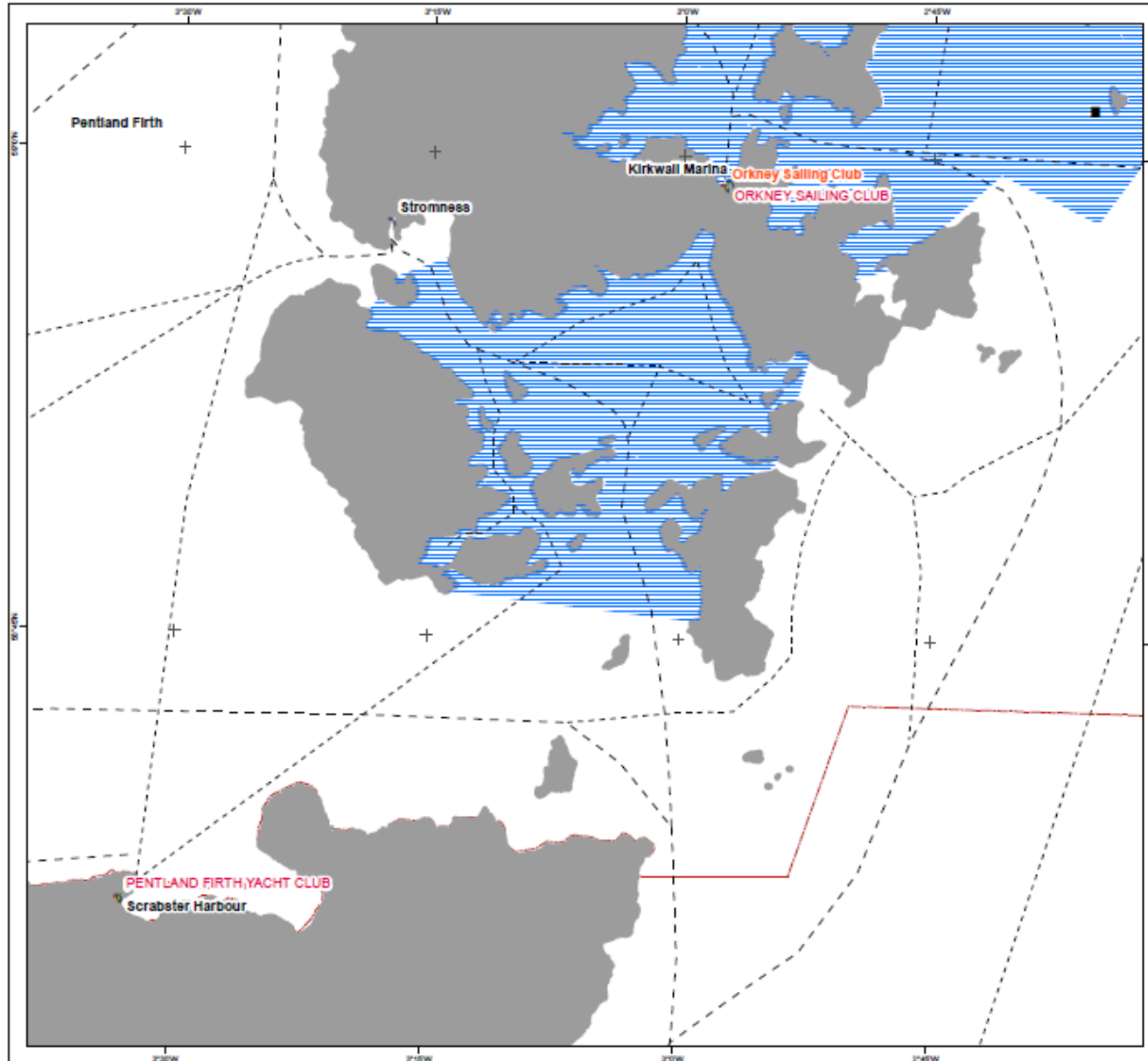


Figure A16b: Recreation and Tourism – Sailing



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Recreation & Tourism - Sailing

Legend

- UK Land
- MGP Study Area
- RYA Club
- ⋄ Marina
- ⋄ RYA Training Centre
- UK Cruising Routes - 2008**
- - - Medium Recreational Use
- ⋯ Light Recreational Use
- ▨ General Sailing Area
- ▨ Racing Sailing Area



Date	Wednesday, May 20, 2009 17:13:42	
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Spheroid	Airy 1830	
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Data Source	TCE, OS, RYA	
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Checked	Produced By	Harshal Gaigale
	Reviewed By	David Wotherspoon

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APPENDIX A: BASELINE FIGURES: SHIPPING, PORTS AND NAVIGATION

Figure A16c: Recreation and Tourism – Sailing

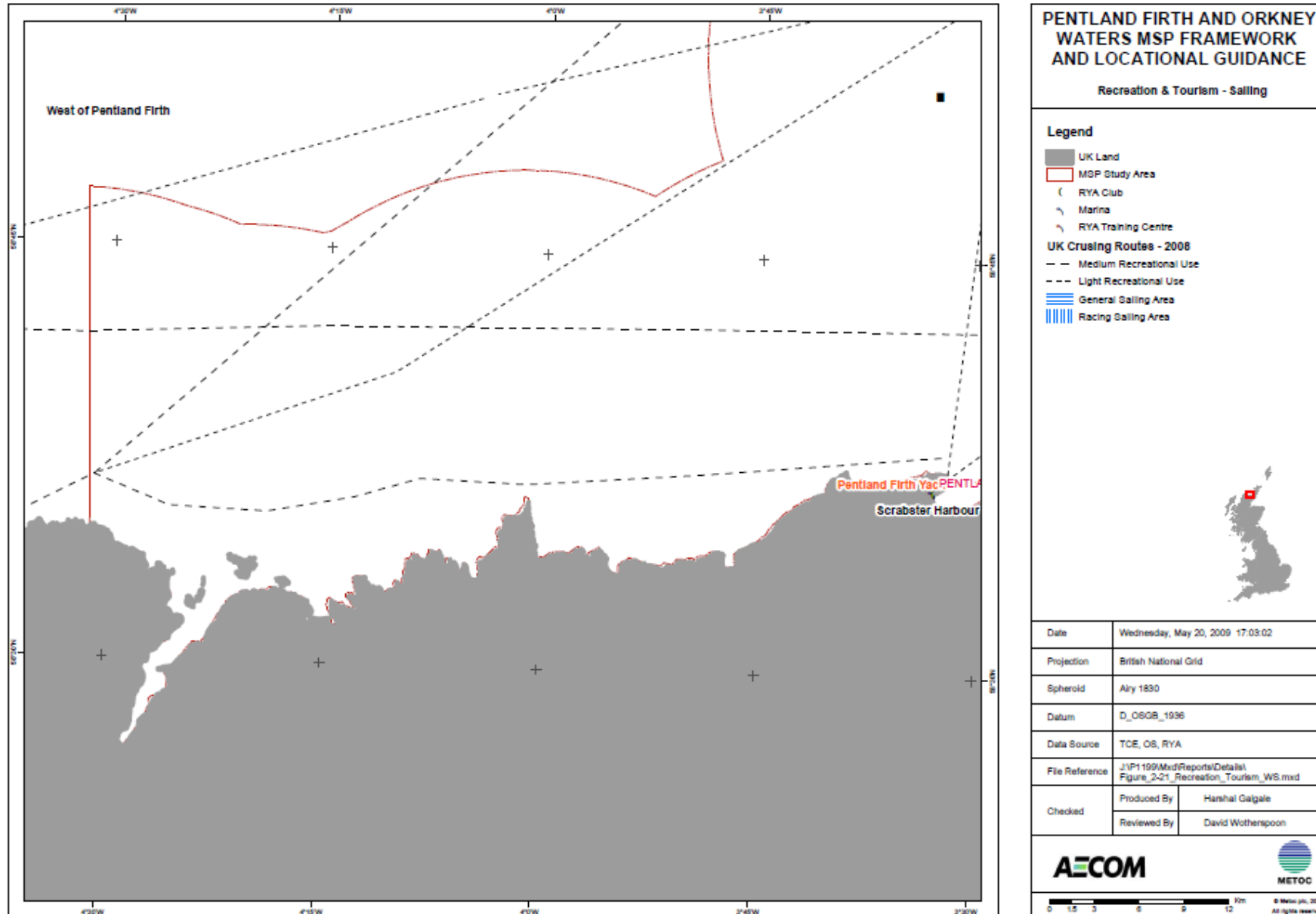


Figure A17a: Shipping and Navigation, Ports and Harbours

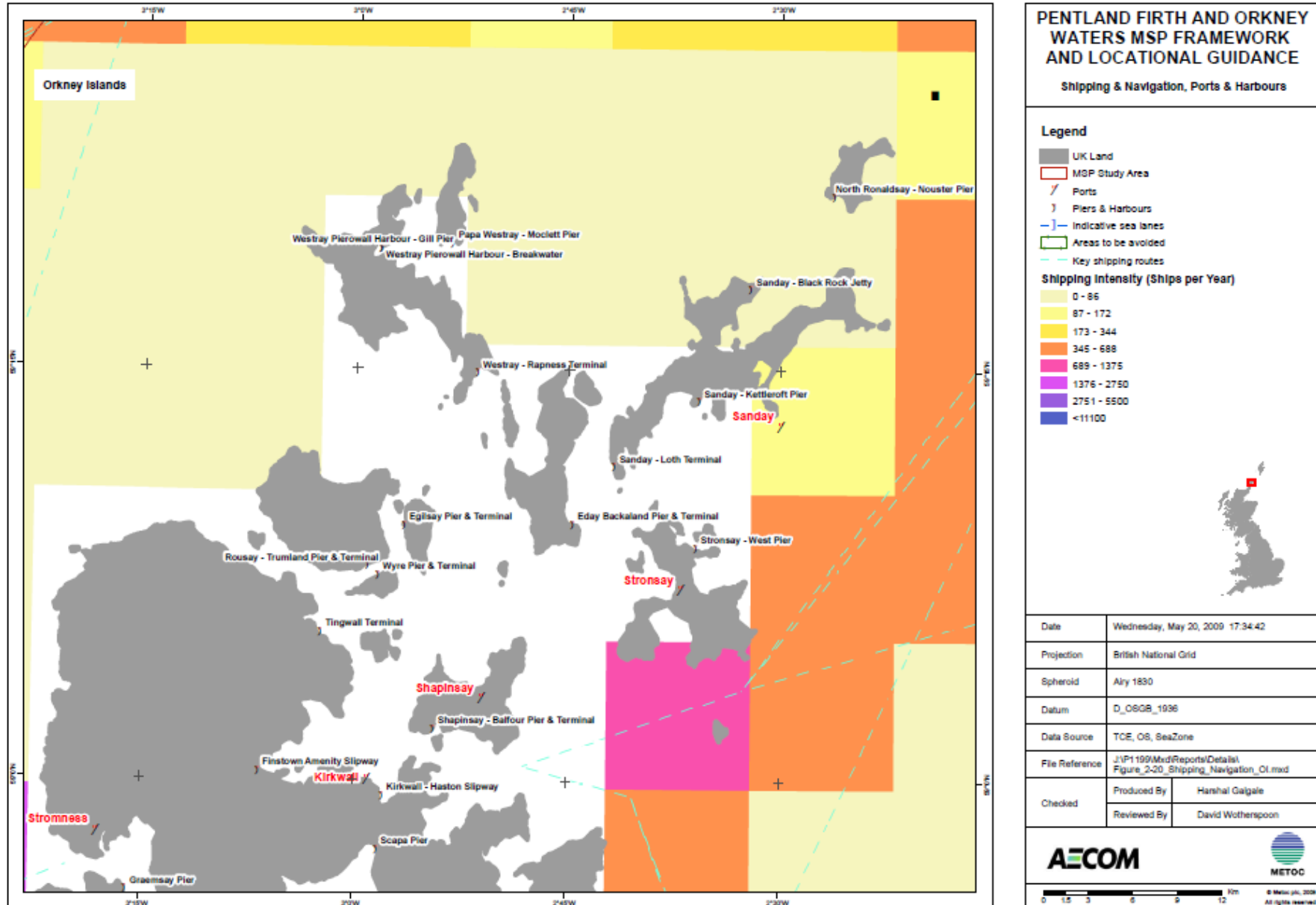


Figure A17b: Shipping and Navigation, Ports and Harbours

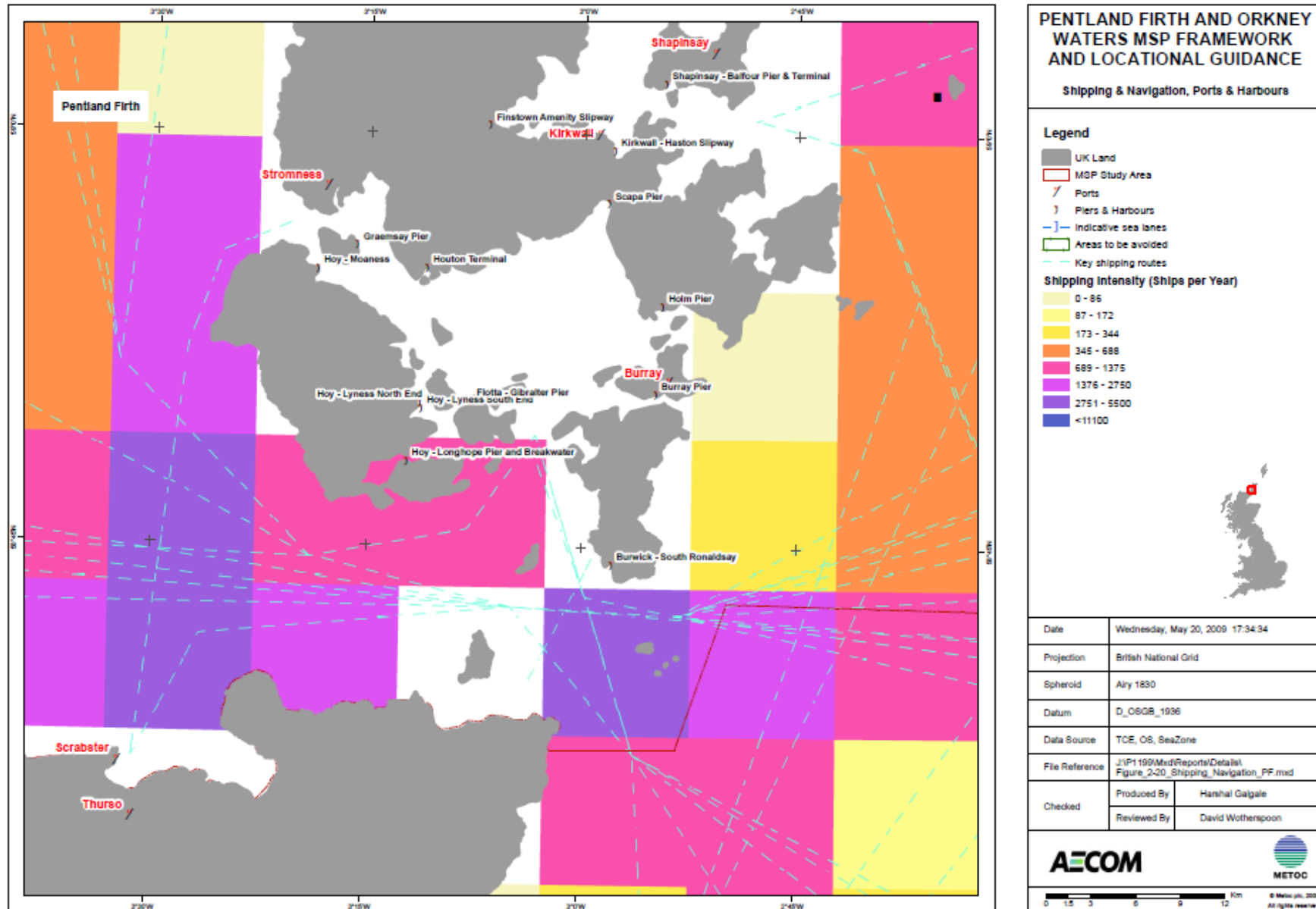
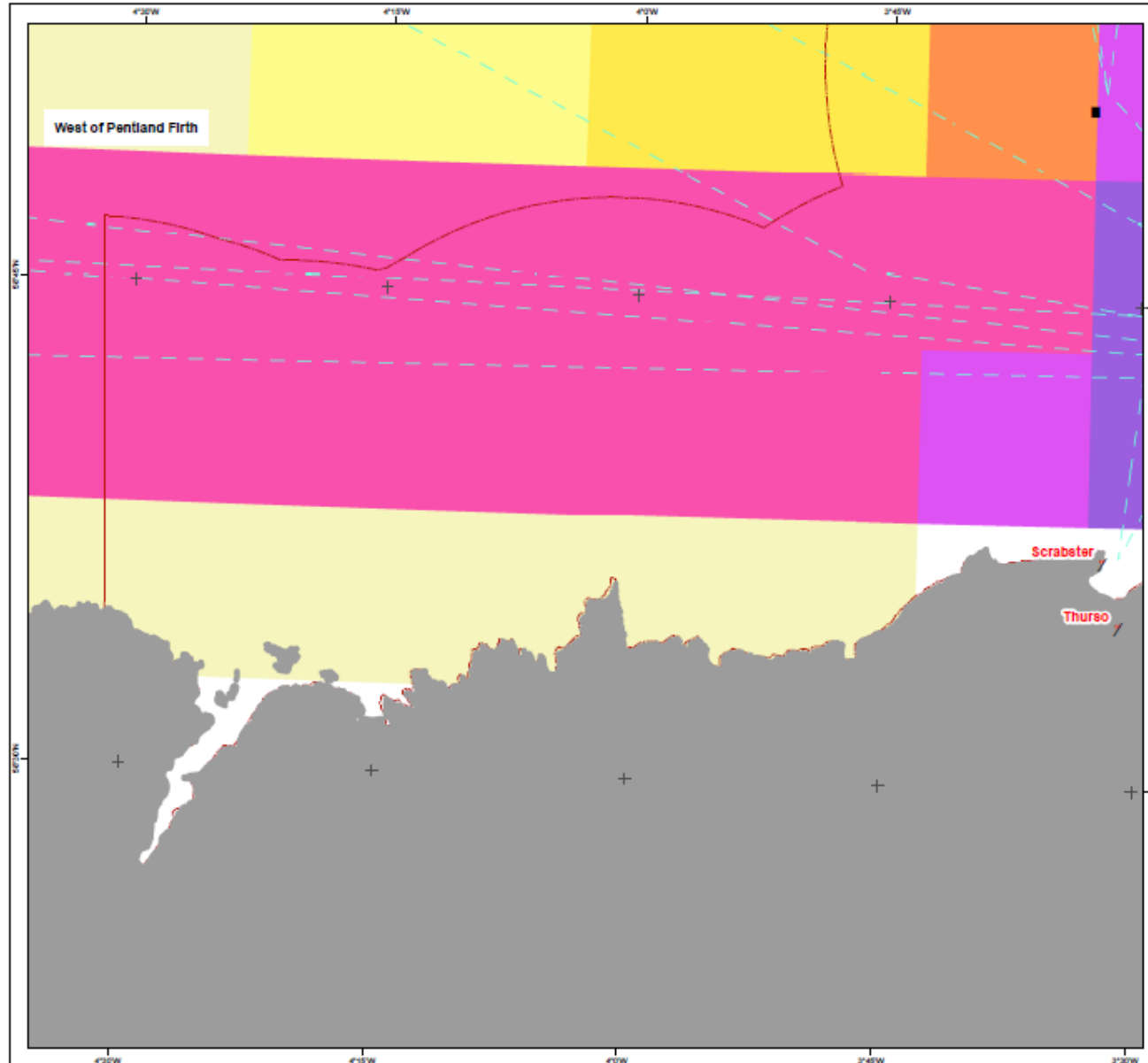


Figure A17c: Shipping and Navigation, Ports and Harbours



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Shipping & Navigation, Ports & Harbours

Legend

- UK Land
- MSP Study Area
- Ports
- Piers & Harbours
- Indicative sea lanes
- Areas to be avoided
- Key shipping routes

Shipping Intensity (Ships per Year)

- 0 - 86
- 87 - 172
- 173 - 344
- 345 - 688
- 689 - 1375
- 1376 - 2750
- 2751 - 5500
- <11100

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Checked	Produced By	Hanshal Gaigale
	Reviewed By	David Wotherspoon

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APPENDIX A: BASELINE FIGURES: WATER QUALITY

Figure A18a: Water Quality Designations and Disposal Sites

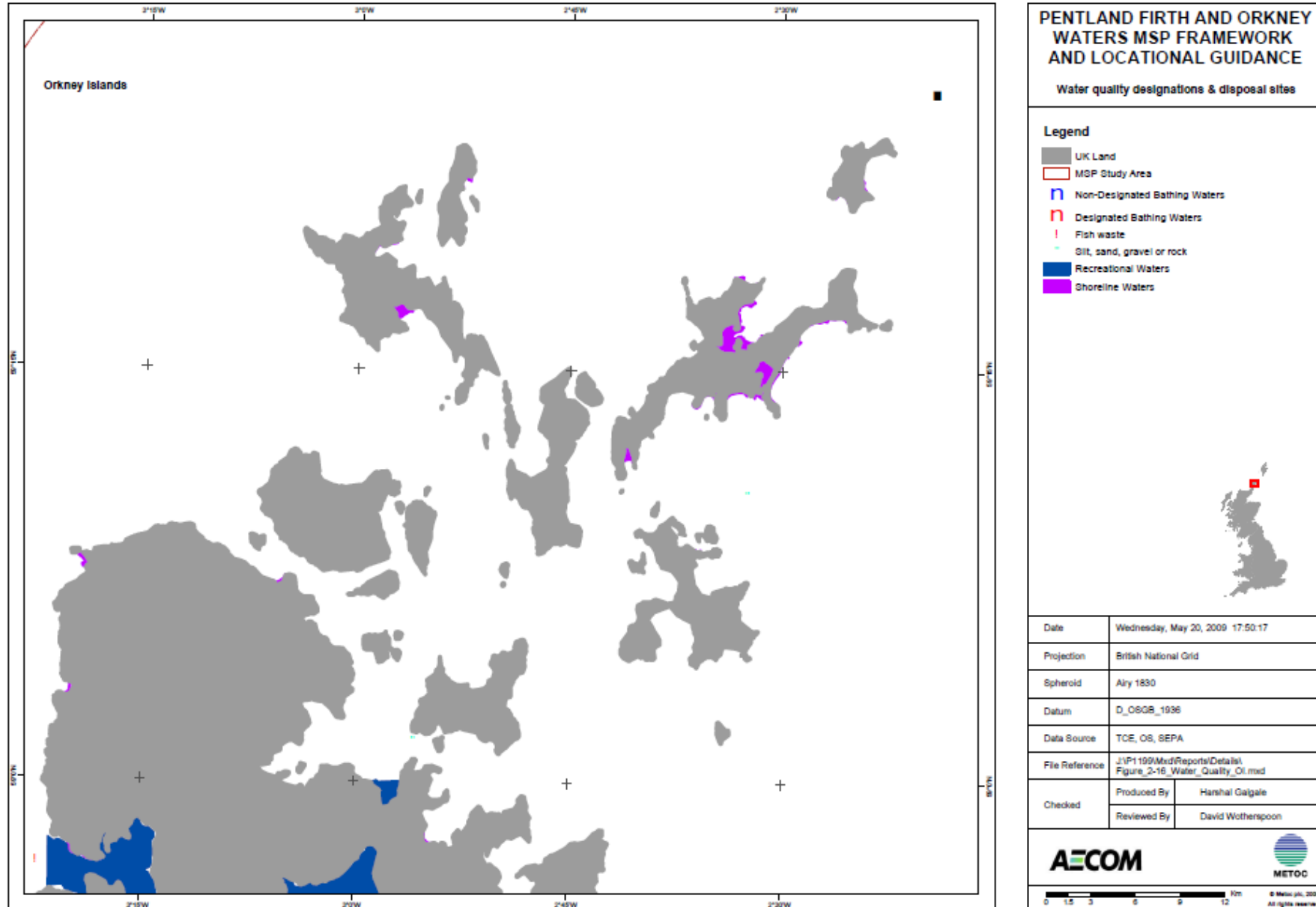
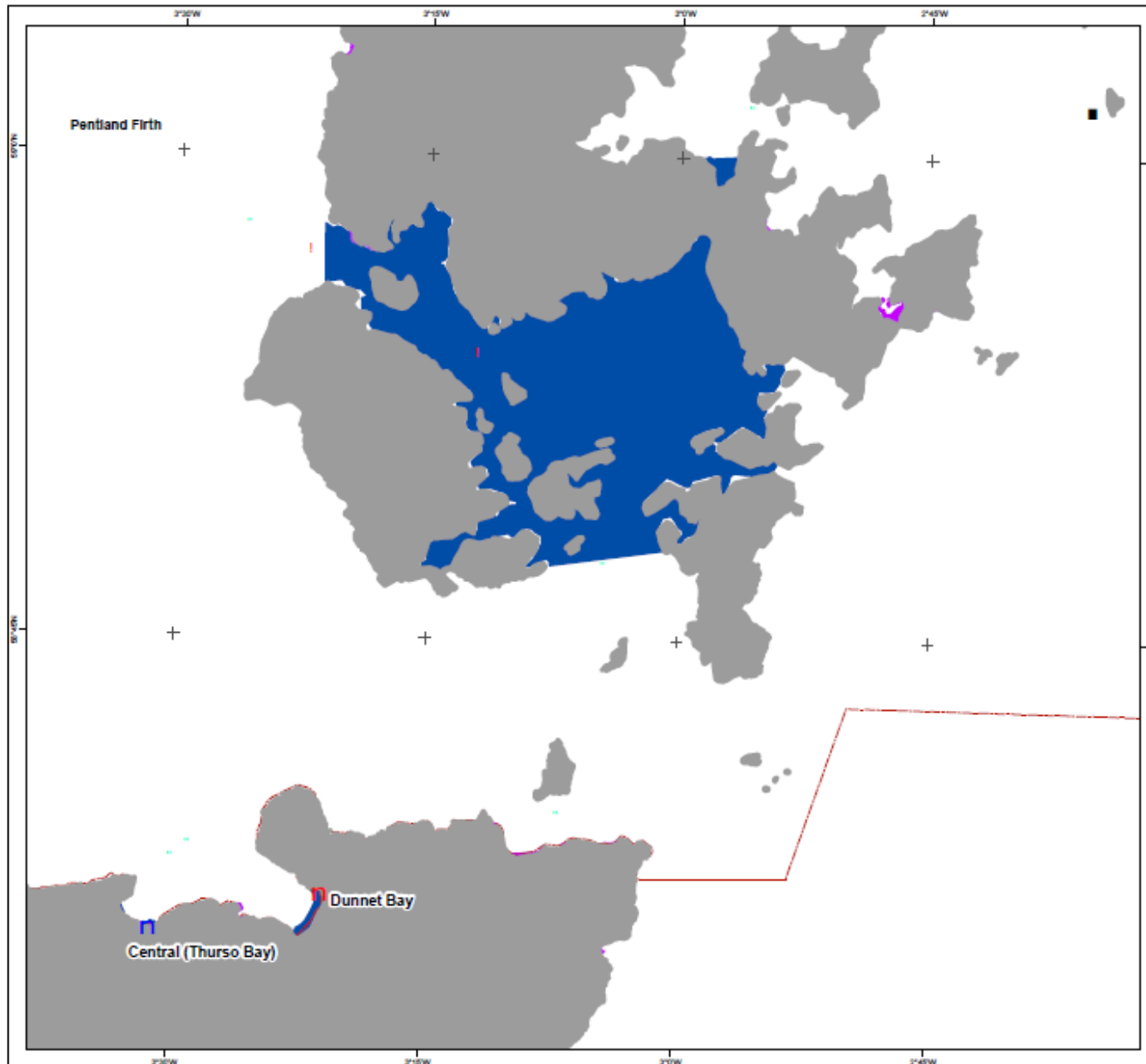


Figure A18b: Water Quality Designations and Disposal Sites



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Water quality designations & disposal sites

Legend

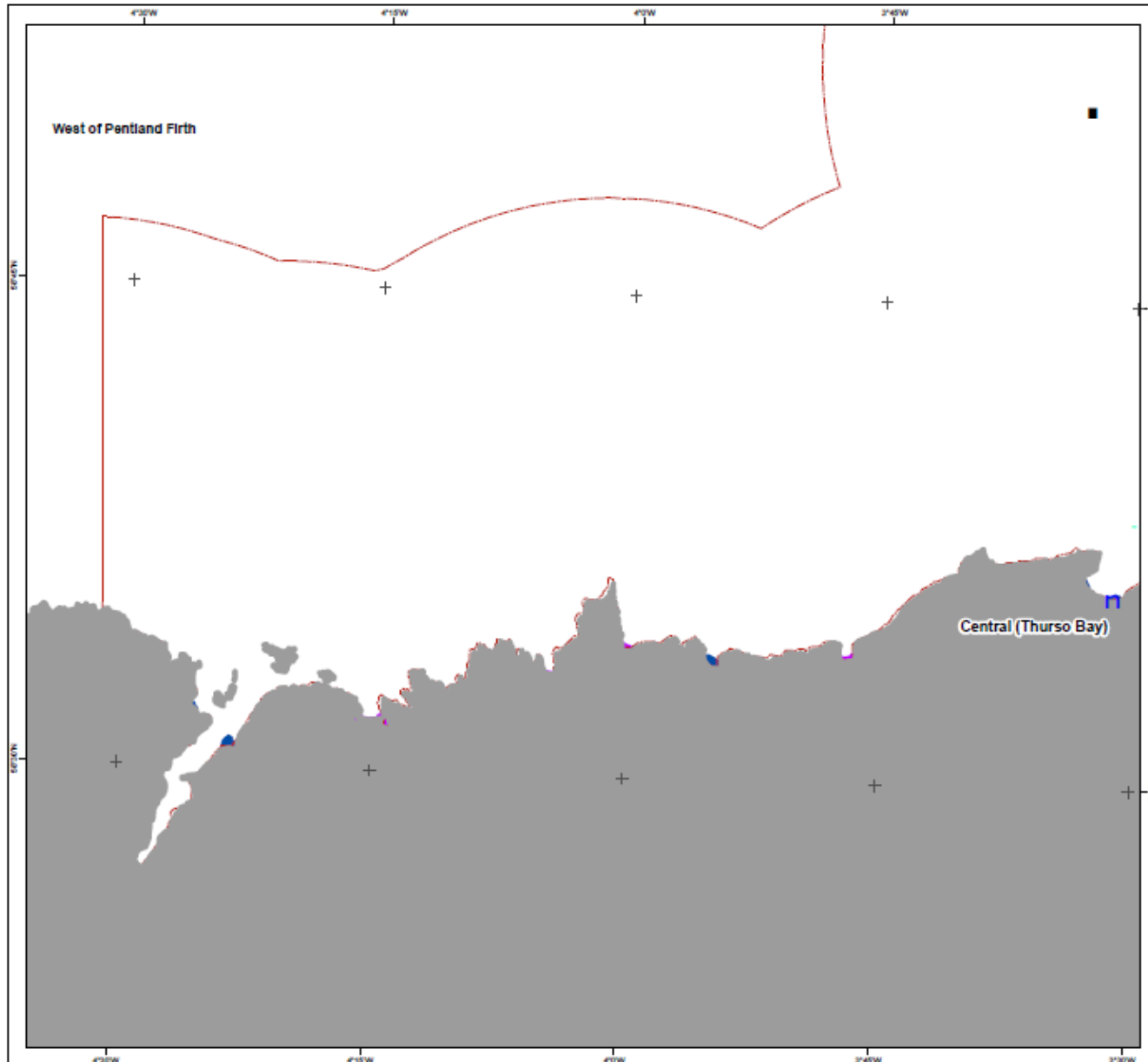
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- Non-Designated Bathing Waters
- Designated Bathing Waters
- Fish waste
- Silt, sand, gravel or rock
- Recreational Waters
- Shoreline Waters

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Checked	Produced By	Harshal Gatgale
	Reviewed By	David Wotherspoon

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Figure A18c: Water Quality Designations and Disposal Sites




PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE

Water quality designations & disposal sites

Legend

- UK Land
- MGP Study Area
- ▭ Non-Designated Bathing Waters
- ▭ Designated Bathing Waters
- Fish waste
- Silt, sand, gravel or rock
- Recreational Waters
- Shoreline Waters

Date	Wednesday, May 20, 2009 17:49:47	
Projection	British National Grid	
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Checked	Produced By	Hanshal Galgale
	Reviewed By	David Wotherspoon

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PART 2:

REGIONAL LOCATIONAL GUIDANCE FOR MARINE ENERGY

SECTION 1: INTRODUCTION TO REGIONAL LOCATIONAL GUIDANCE FOR MARINE ENERGY

FOCUS OF THE REGIONAL LOCATIONAL GUIDANCE (RLG) FOR MARINE ENERGY

The Regional Locational Guidance (RLG) for Marine energy (wave and tidal stream energy) has been prepared in support of the MSP Framework and the rapid increase in interest in the development of wave and tidal energy within the Pentland Firth.

The aims of the RLG are twofold:

1. Provide guidance to marine renewable energy developers on potential areas of opportunity for future development and to highlight likely requirements for surveys, monitoring or interactions with existing uses that may be issues for development.
2. Progress the marine spatial planning process in a way which enables stakeholders and decision makers to respond to the rapid increase in interest in marine renewable energy developments whilst enabling 'issues' relating to other marine sectors to be examined over a longer timescale as part of the preparation of the statutory MSP.

An outline of the approach taken to prepare the RLG is shown in Diagram 1 below.

One of the first stages in developing the RLG is to understand the potential for different types of marine renewable energy developments that could occur within the Pentland Firth and Orkney Waters, based on the available wave and tidal resource and current technologies. However, the RLG will not provide information on specific technical and operational constraints (technological issues) nor economic constraints associated with different technologies.

In identifying key characteristics associated with marine developments the following factors have been used:

- n Device characteristics:
 - o Tidal devices - minimum water depth 30m
 - o Tidal devices – tidal current >1 m/s average
 - o Wave devices – minimum water depth 10m
 - o Wave devices – minimum wave energy approx. 20kW/m

No effective maximum water depth has been applied as the water depths within the 12 nautical mile limit forming the boundary of the zone are typically less than

100m. It is recognised that depths greater than 60m may be a current economic/practical limit for seabed tidal devices, but deeper deployments may be viable. Wave devices are capable of significantly greater water depth deployment due to the use of moorings.

Tidal devices operating in water depths of less than 30m may be feasible in areas where vessel movements may be excluded or where development of the device results in a very low height requirement.

Bathymetry information has been obtained from UKHO admiralty chart data (Seazone). Given the age and limited sounding information used to form these charts, it is likely that there are areas where the actual bathymetry may vary significantly from that currently recorded.

Tidal current information has been based on a hydrodynamic model operated by Metoc based on a 200m rectilinear grid. The model is adequate for identifying the main resource areas but may be too coarse for the inter-island areas with narrow channels and poorly resolved bathymetry data.

Wave resource data is based on output provided by Aquamarine Power and based on a flexible mesh model calibrated against local data. Again, the paucity of bathymetry data in the area represents a constraint to model accuracy, but it is sufficiently accurate for planning purposes.

SECTION 1: INTRODUCTION TO REGIONAL LOCATIONAL GUIDANCE FOR MARINE ENERGY

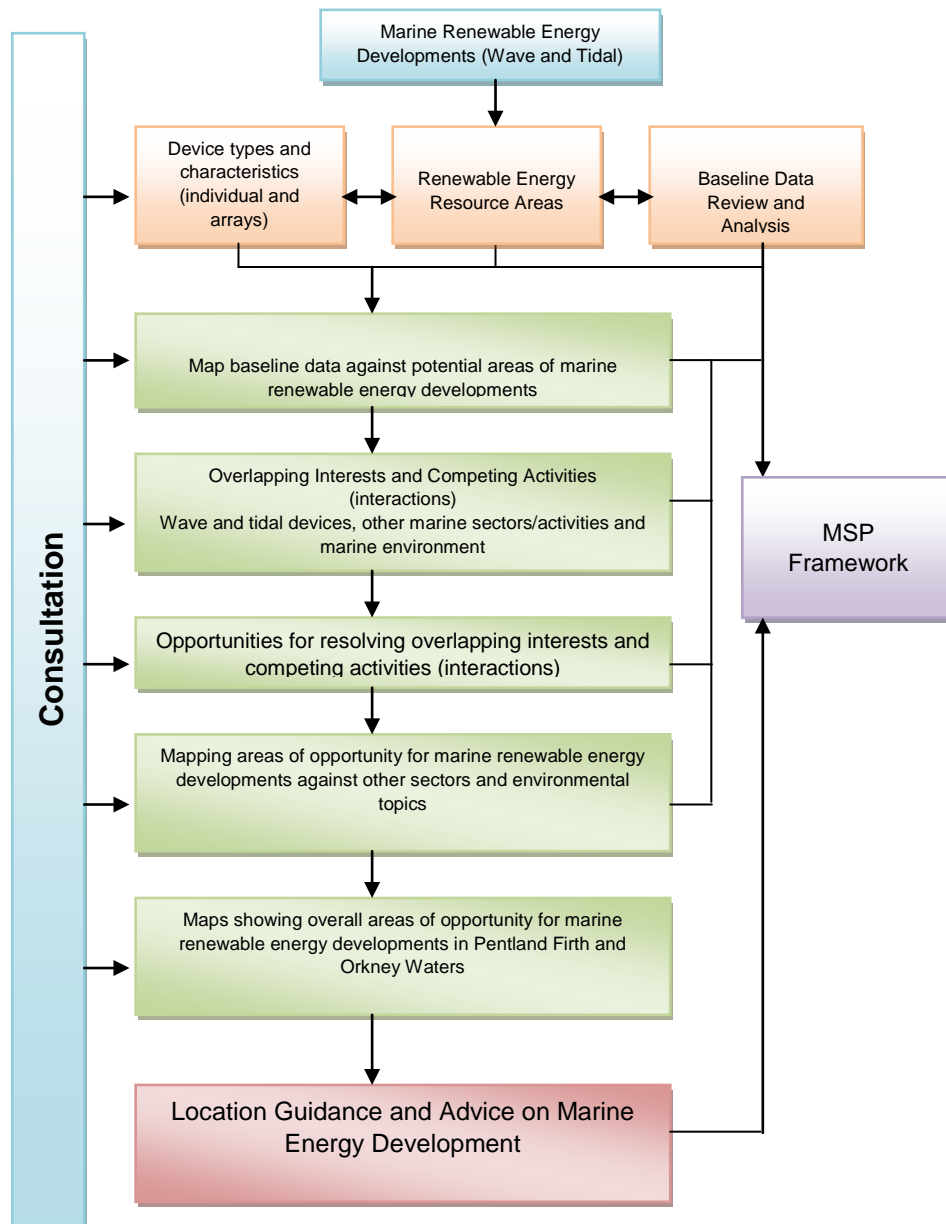


Diagram 1.1: Approach to RLG for Marine Energy

SECTION 2: WAVE AND TIDAL RESOURCES

AREA OCEANOGRAPHIC OVERVIEW

This section provides a summary of wave and tidal resources with reference to bathymetry, tidal currents, and waves.

Bathymetry

Water depths within the bays and channels of the Orkney Islands are generally less than 25m (referenced to Chart Datum), and rarely exceed 40m (from UKHO Admiralty Charts).

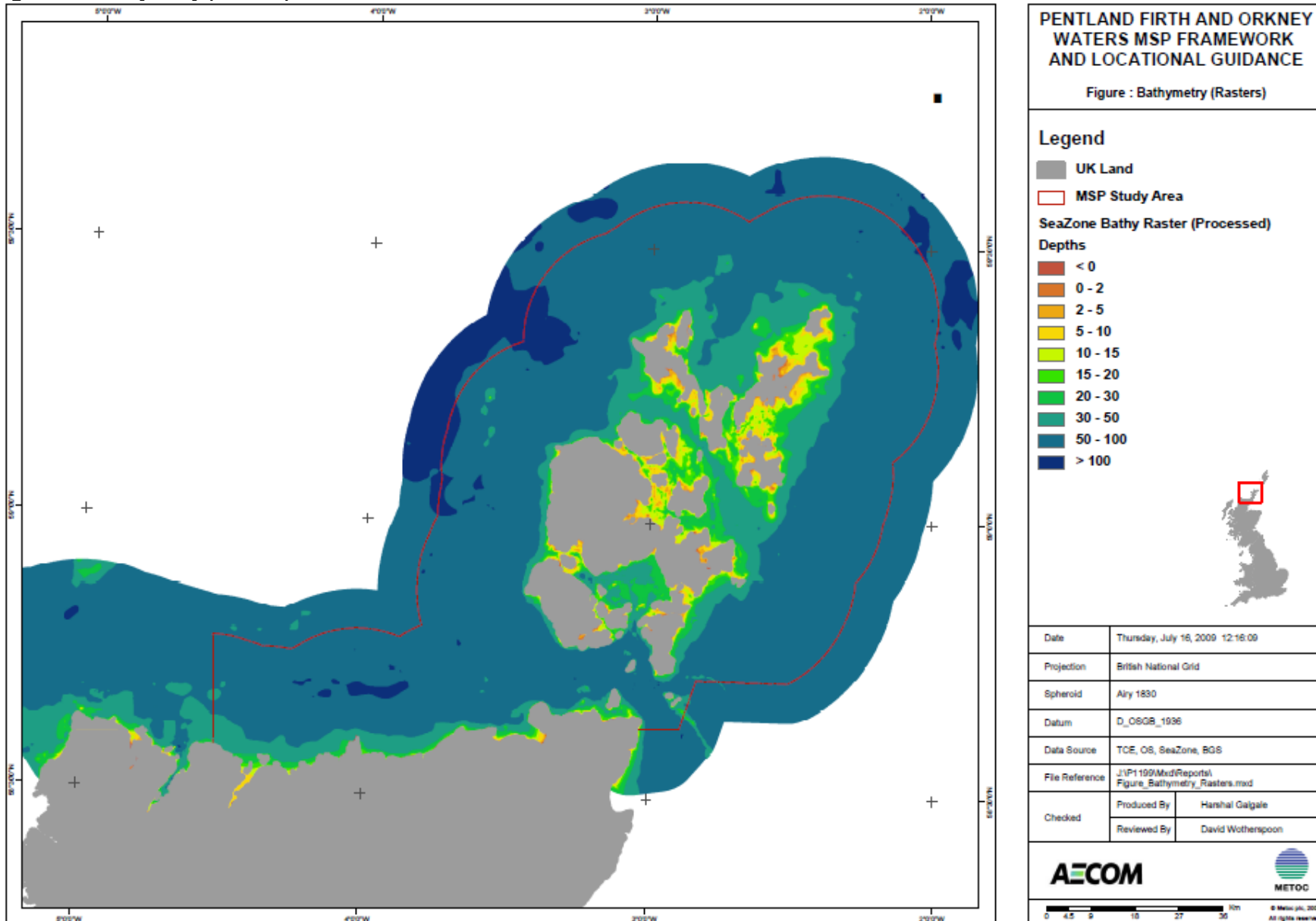
The Pentland Firth is significantly deeper, with depths in the main channel typically lying in the range 60-80m. Depths of over 90m are found in the western part of the Firth, between Hoy and Dunnet Head. The Inner Sound, south of the Island of Stroma, is somewhat shallower, reaching a maximum depth of around 35m.

Along the north coast of Scotland, between Loch Eriboll and Dunnet Head, the seabed typically drops rapidly to depths of 30m, and then continues dropping at a shallower gradient to depths of at least 60-80m, and over 100m in some areas to the north of Strathy Point.

The figure below displays charted bathymetric data for the study area. An understanding of the bathymetry is important as site selection of renewable devices will be, in part, limited by the depth ranges at which the devices can operate. Marine Scotland Science have undertaken bathymetric surveys in the area in 2008 and 2009 (not included on the figure below)

SECTION 2: WAVE AND TIDAL RESOURCES

Figure 2.1: Bathymetry (Rasters)



SECTION 2: WAVE AND TIDAL RESOURCES

Tidal Currents

Tidal currents within the area of interest are complex. The area lies close to the boundary between the North Atlantic and North Sea tidal systems. The incoming North Atlantic tidal wave reaches the Orkney Islands several hours before the North Sea tidal wave, causing a net flow of water from west to east on the flood tide, particularly through the Pentland Firth (Dacre *et al* 2001). The interaction of the two tidal systems results in a dynamic and energetic tidal regime throughout the area of interest. However, this flow is strongly modified by local conditions of water depth and topography. Tidal races and eddies are typical throughout the area. These have the effect that frequently the flood and ebb tides do not directionally oppose one another, which might be an important consideration in the siting of tidal power devices.

Flows are strongest where the tide is forced through a constrained channel (such as the Pentland Firth and some of the channels within the Orkney Islands), and also where the tide is forced around a headland (such as to the north of Papa Westray and North Ronaldsay).

Orkney Islands

Tidal current flow through the Orkney Islands is dictated by water depth and topography. The islands form a barrier to the flooding North Atlantic tidal wave as it rounds the north of Scotland to enter the North Sea, and form a similar barrier to the ebbing tide travelling in the opposite direction. The effect of this barrier is to force strong current flows north and south of the islands, and through the various channels that dissect them. The areas of strongest tidal flow are described below (UKHO, 1986b and 1997 plus Admiralty Charts).

Where the tidal wave is diverted to the north of the Orkney Islands it causes strong flows close to the coast, which tend to diminish as distance from land increases. To the north of Papa Westray, spring rates of 3ms^{-1} are typical on both flood and ebb. Eddies and races can form on both flood and ebb tides, particularly if the wind is opposing the flow. On the west-going ebb tide, the race **north of Papa Westray** is referred to as The Bore Röst. To the **north and northeast of North Ronaldsay**, spring tidal flows of 3ms^{-1} can occur on both flood and ebb.

Strong tidal flows occur in many of the channels between the Orkney Islands. In the **North Ronaldsay Firth** between North Ronaldsay and Sanday, spring flood and ebb rates of over 2ms^{-1} can occur, as well as eddies, overfalls and tidal races in both directions. In **Lashy Sound**, the northern part of **Eday Sound** between Eday and Sanday, peak spring rates of 3.0ms^{-1} occur on both flood and ebb. Similar rates occur in **Calf Sound** between Eday and Calf of Eday, and heavy tidal races can occur both here and in Lashy Sound, particularly when north-going tides are opposed by a strong northerly wind.

Westray Firth and **Stronsay Firth** together form the main channel through the Orkney Islands for the flooding and ebbing tide. As such, they exhibit strong tidal flows in both directions, as well as many areas of tidal races, eddies and overfalls, all of which can form at short notice depending on location, tidal state, wind conditions and associated factors. Some of these features are prominent enough to be named, such as the Rull Röst northeast of Rousay and the Fall of Warness south of Eday. In Westray Firth between Westray and Rousay, peak flows on a mean spring tide can be 3.5ms^{-1} or greater on the southeast-going flood, and somewhat lower on the northeast ebb. In Stronsay Firth between Shapinsay and Stronsay, peak spring tidal flows of 2ms^{-1} are reported on both flood and ebb to the northeast of Shapinsay, diminishing as the Firth opens out to the southeast.

Another flow channel through the Orkney Islands follows the northeast coast of Mainland. This series of channels also has locations of strong tidal flow, tidal races and pronounced eddies. In **Eynhallow Sound** between Mainland and Rousay, peak spring rates of 1.5ms^{-1} are typical, but they can exceed 3.5ms^{-1} northeast and southwest of the small mid-channel island of Eynhallow (the resultant races are referred to as the Weal Race and Burger Röst, respectively). Further southeast, **between Mainland and Gairsay**, there are strong eddies and turbulence associated with peak spring speeds of about 2ms^{-1} . In **The String and Shapinsay Sound** between Mainland and Shapinsay, peak spring rates of 2ms^{-1} are also typical. Similar current speeds, and possibly slightly higher, occur at locations to the west of Shapinsay, where a complex system of shoals and channels results in turbulent current flow and numerous areas of tidal races and eddies.

In the southern part of the Orkney Islands, there are areas of very strong current flow through the channels leading to Scapa Flow. The island of Graemsay lies in Hoy Sound, the northwest entrance to Scapa Flow between Mainland and Hoy. **North and northwest of Graemsay**, the strong flows cause an extensive area of races, overfalls and eddies, which are most pronounced at certain states of tide

SECTION 2: WAVE AND TIDAL RESOURCES

and under certain weather conditions. Peak spring rates exceed 4ms^{-1} in the most constricted part of the channel. In **Burra Sound**, southwest of Graemsay, peak spring rates of 3ms^{-1} are more typical. The **Sound of Hoxa**, between Flotta and South Ronaldsay, forms the southern entrance to Scapa Flow. Tidal streams are generally weaker here than in other channels, with a peak spring speed of about 1ms^{-1} , although rates of 2ms^{-1} are reported off the southeast tip of Flotta. However, this is an area of complex eddies and unequal flood and ebb streams, due to interaction with the flows through the Pentland Firth.

Pentland Firth:

Tidal currents within the Pentland Firth are very complex and highly variable, due to the strong flows and the presence of reefs and islands, variable water depths, and the influence of the weather. This section presents a summary of the main flow features (UKHO, 1986b and 1997 plus Admiralty Charts).

West of the main part of the Firth (i.e. **west of Dunnet Head**), peak spring current speeds of 1.5ms^{-1} are typical on both flood and ebb. However, flows increase significantly eastwards into the Firth, and there are widespread and highly energetic tidal races, eddies, overfalls and areas of general turbulence. **Between Tor Ness on Hoy and St John's Point on the Scottish mainland**, the Merry Men of Mey is one of the most significant oceanographic features in the Firth. This is an area of tidal racing that occurs on the west-going ebb, particularly when opposed by westerly wind or waves. The feature can extend right across the width of the Firth, and is characterised by strong flows (peak spring rates in excess of 3ms^{-1}) and significant standing waves which frequently break and have been reported to exceed 10m in height on occasion.

The central part of the Pentland Firth may be split into three channels. These are, from north: the channel between the island of Swona and the Orkney Islands of South Walls (Hoy) and South Ronaldsay; the Outer Sound between Swona and the Island of Stroma; and the Inner Sound between the Island of Stroma and the Scottish mainland. The **channel between Swona and South Walls** experiences spring rates of 2.5ms^{-1} , while the **channel between Swona and South Ronaldsay** has spring rates of 4ms^{-1} on the eastern side. Swona itself causes extensive eddies to its east during the east-going flood tide, and similarly to its west during the ebb. There are also significant tidal races both north and south of the island, as there are to the south of South Ronaldsay.

The **Outer Sound** between Swona and the Island of Stroma has peak spring speeds of about 4.5ms^{-1} on both flood and ebb tides. These flows cause an

almost continuous tidal race north of the Island of Stroma, referred to as The Swilkie. The Island of Stroma also generates extensive eddies on its downstream side during both flood and ebb flows. The **Inner Sound** between the Island of Stroma and the Scottish mainland experiences peak spring flows of about 2.5ms^{-1} . There are significant tidal races southwest of the Island of Stroma and further east offshore the Ness of Duncansby on the mainland (the Duncansby Race).

Some of the strongest currents of all are found in the eastern part of the Pentland Firth. **Between North Ronaldsay and Muckle Skerry**, peak spring rates can reach 4ms^{-1} , particularly in mid-channel where an area of races, overfalls and eddies is referred to as the Liddel Eddy. Peak spring rates of 4ms^{-1} are also typical of the channel **between the Pentland Skerries and Duncansby Head** on the mainland, although close in to the Pentland Skerries flows as high as 6ms^{-1} are reported. The Pentland Skerries cause eddies on both flood and ebb tides.

North Coast of Scottish Mainland:

Compared to the highly energetic and complex current regime of the Orkney Islands and Pentland Firth, tidal flows along the north coast of the Scottish mainland may be considered relatively benign (UKHO, 1986b and 1997 plus Admiralty Charts). In general terms, tidal flows set to the east during the flood tide and to the west during the ebb, travelling roughly parallel with the coast (although there is some eddying in the vicinity of the more pronounced headlands and bays).

Tidal current speeds are significantly lower than elsewhere in the area of interest, with peak spring flows generally not exceeding 0.75ms^{-1} on either flood or ebb. Such flows occur in the offshore regions and close to the prominent headlands such as Strathy Point. In less prominent near-coast areas, flows are weaker still and unlikely to exceed 0.5ms^{-1} as a peak spring rate.

SECTION 2: WAVE AND TIDAL RESOURCES

Waves

The wave climate in the area of interest is dominated by the passage of low pressure systems from west to east across the North Atlantic. In general terms the highest waves approach the Orkney area from westerly directions; these are also the directions from which waves most frequently occur.

Information on Wave Heights is provided below. The following figures (taken from BODC, 1998) plot the significant wave heights that are exceeded for different proportions of the year across the area of interest. Wave conditions are most severe (i.e. the wave field contains the greatest energy) in the exposed coastal areas to the west of the Orkney Islands. East of the Orkney Islands, the wave climate is less severe due to sheltering from the dominant westerlies, even though these sites are correspondingly more open to waves from northeast, east and southeast in the North Sea. Along the north coast of Scotland, the mainland itself and the northern tip of the Hebrides will result in sheltering for wave directions south of west, which will reduce the energy available in the wave field.

SECTION 2: WAVE AND TIDAL RESOURCES

Figure 2.2a: Significant wave height exceeded for 75% of the year

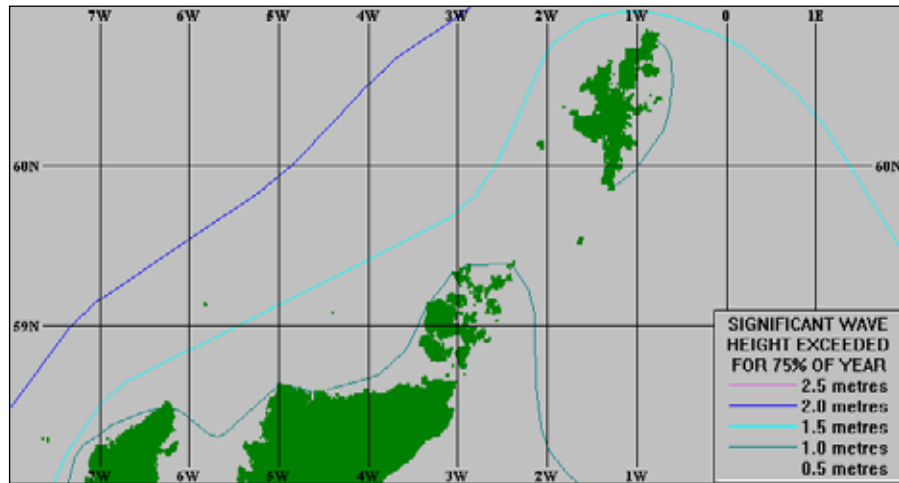


Figure 2.2c: Significant wave height exceeded for 25% of the year

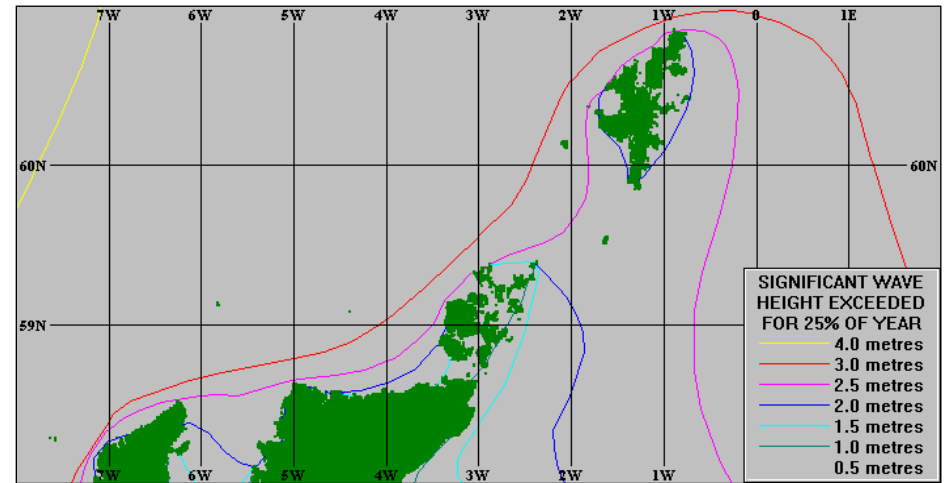


Figure 2.2b: Significant wave height exceeded for 50% of the year

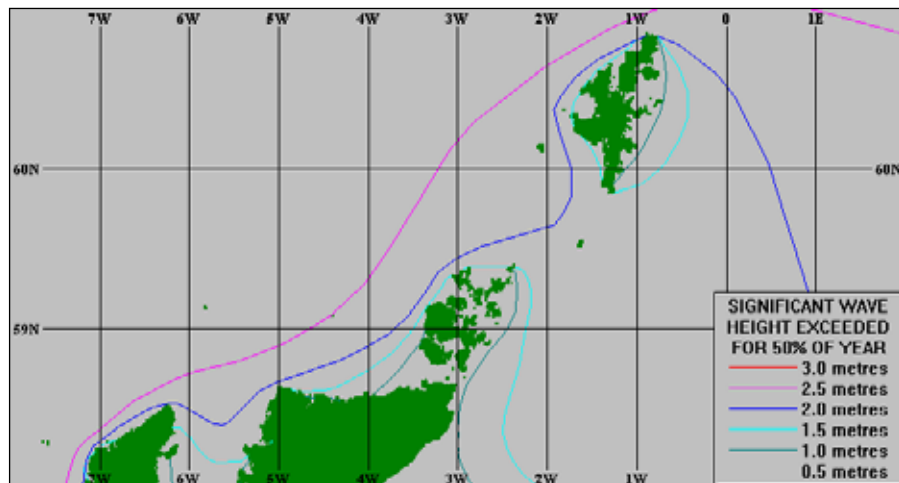
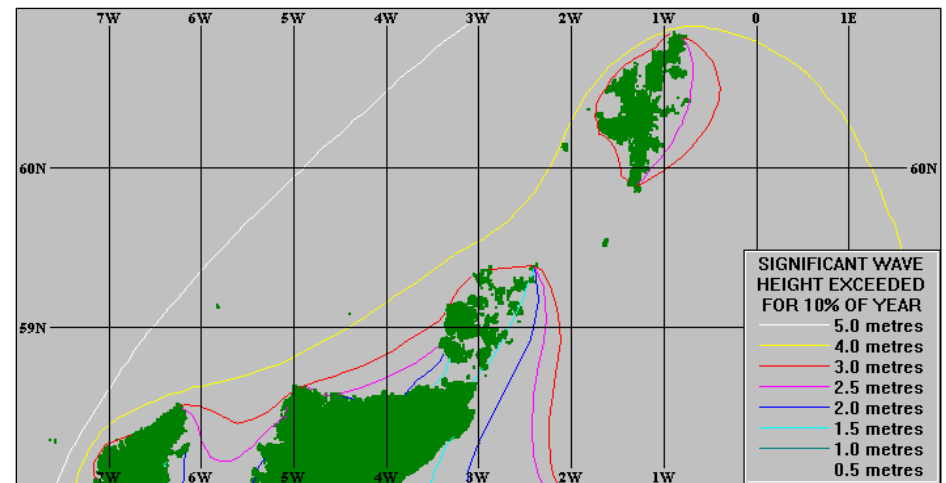


Figure 2.2d: Significant wave height exceeded for 10% of the year



SECTION 2: WAVE AND TIDAL RESOURCES

The following figures (taken from ABPmer *et al* 2008) show annual and seasonal values for mean significant wave height. In the most exposed part of the area of interest, west of Westray in the northwest Orkney Islands, the annual mean significant wave height is within the range 2.25-2.5 m. The average summer height at the same location is 1.5-1.75 m, and in winter it is 3.0-3.25 m. Compared to this exposed location west of Westray, average wave heights throughout the year are typically at least 0.5 m lower to the west of Hoy; at least 0.75 m lower along the north coast of the Scottish mainland; and over 1.0 m lower within the Pentland Firth.

Shallow Water Effects:

Water depth and seabed topography both have important effects in modifying incoming waves. As waves pass from deep water into shallower coastal waters, they begin to interact with the seabed. This causes the waves to slow down and steepen, ultimately to the point where their increasing steepness becomes unstable and wave breaking occurs. The effect of seabed interaction also causes waves to lose energy, thus reducing the amount of energy potentially available for wave power devices. These processes explain why wave heights, and the associated wave energy, tend to be lower in shallower, near-coast areas. Average wave heights in the Pentland Firth are lower than those northwest of the Orkney Islands due to the combined effects of sheltering and shallow water depths.

SECTION 2: WAVE AND TIDAL RESOURCES

Figure 2.3a: Annual Mean Significant Wave Height

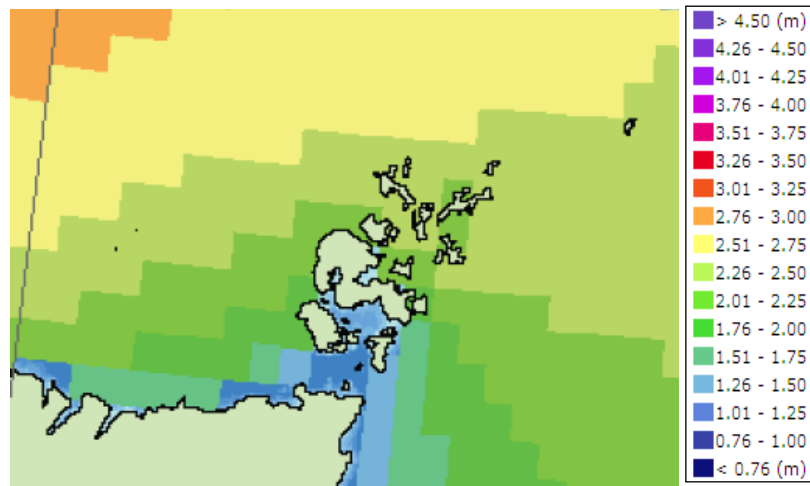


Figure 2.3c: Summer Mean Significant Wave Height

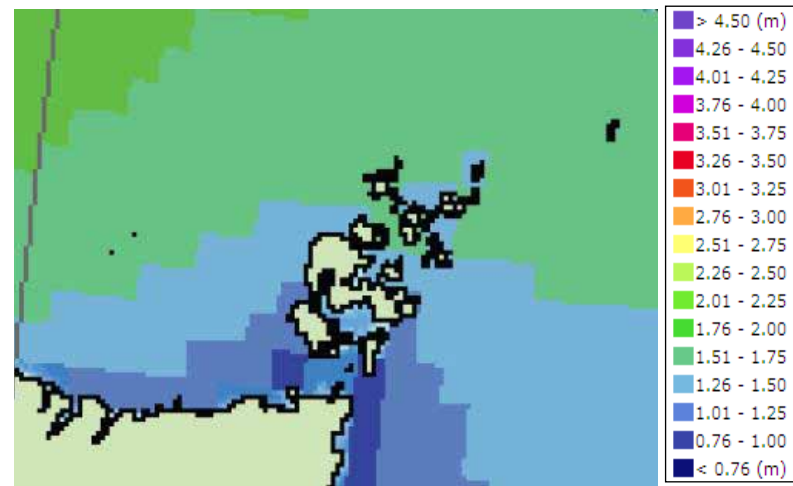
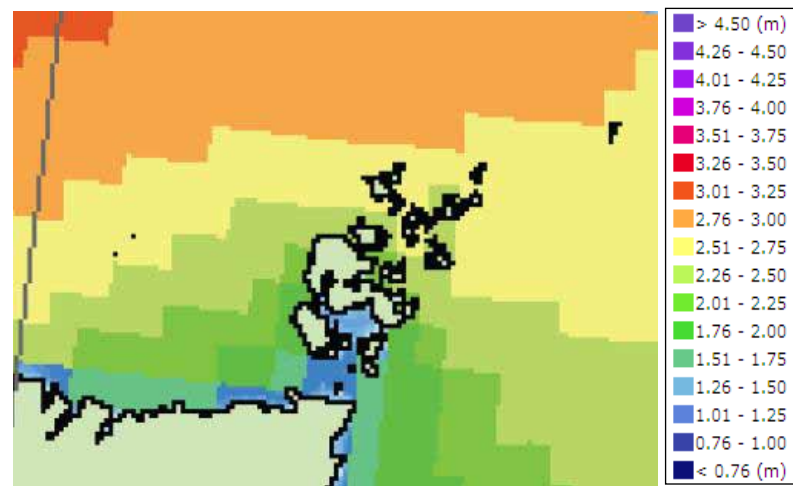


Figure 2.3b: Spring Mean Significant Wave Height

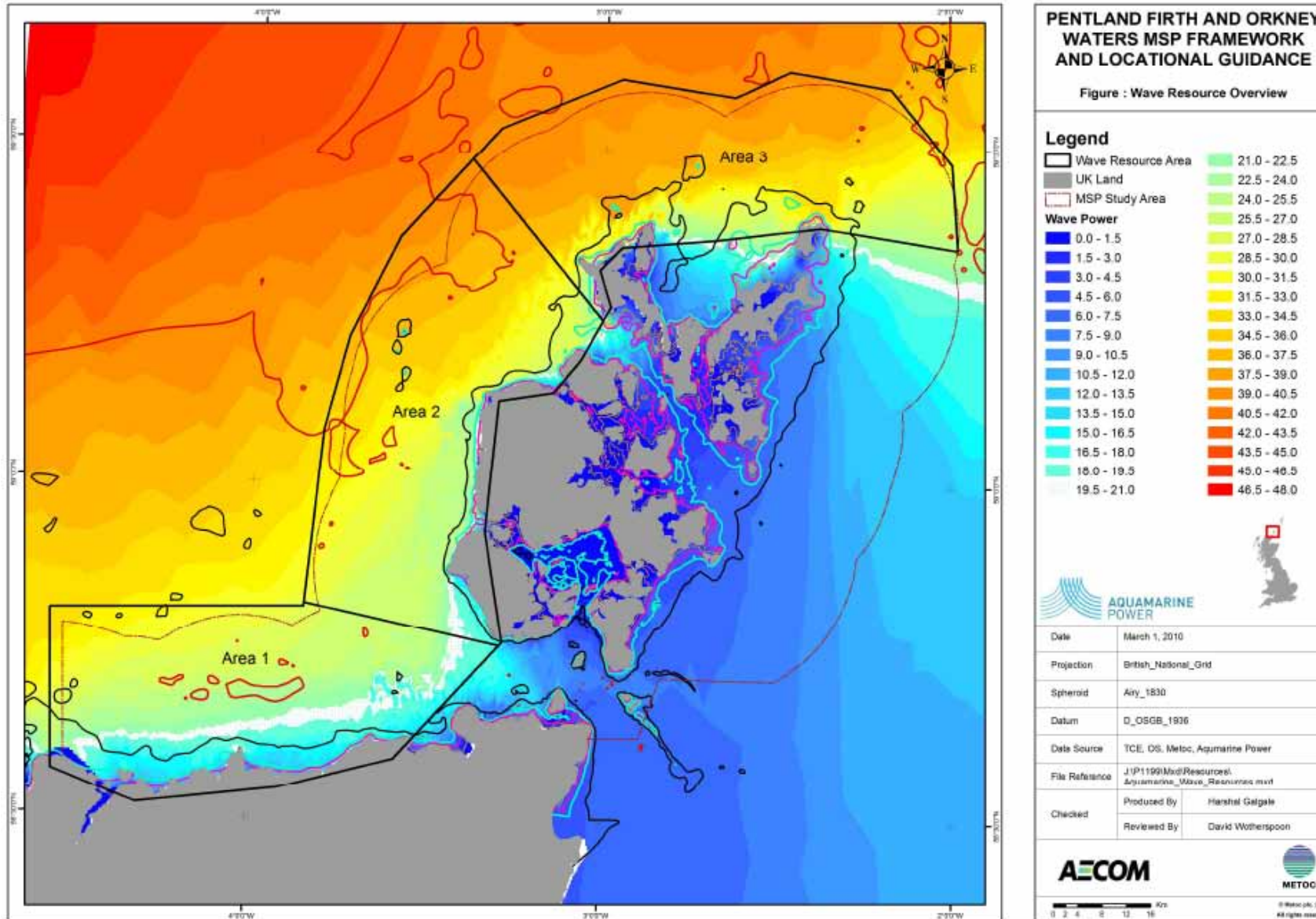


Figure 2.3d: Autumn Mean Significant Wave Height



SECTION 2.1: WAVE RESOURCE AREAS

Figure 2.4a: Wave Resource Overview



SECTION 2.1: WAVE RESOURCE AREAS

The potential area available for exploitation of the wave resource is effectively bounded by the western edge of the 12 nautical mile limit, encompassing the Caithness coastline, west coast of Orkney Mainland and the west and north coasts of the northern Orkney Isles. The wave resource has been split into three broad areas of opportunity as identified in Wave Resource figure provided above.

Area 1 – Whiten Head to Thurso

Area 2 – Hoy/Mainland/Rousay

Area 3 – Westray to North Ronaldsay

A potential lower band of interest in wave power of approximately 20kW/m has been differentiated on the wave power mapping to highlight the potential inner bound of development.

Plans of each wave area are provided in the following pages with brief descriptions below.

Wave Area 1 – Whiten Head to Thurso

Suitable wave energy potential exists off the Caithness mainland. Within the 12 nautical mile limit the energy potential is lower than that immediately outwith this boundary. The energy levels close to shore are generally lower than the Orkney islands, with wave resource of greater than 20kW/m occurring some 15 km from the mainland

Wave Area 2 –Hoy/Mainland/Rousay

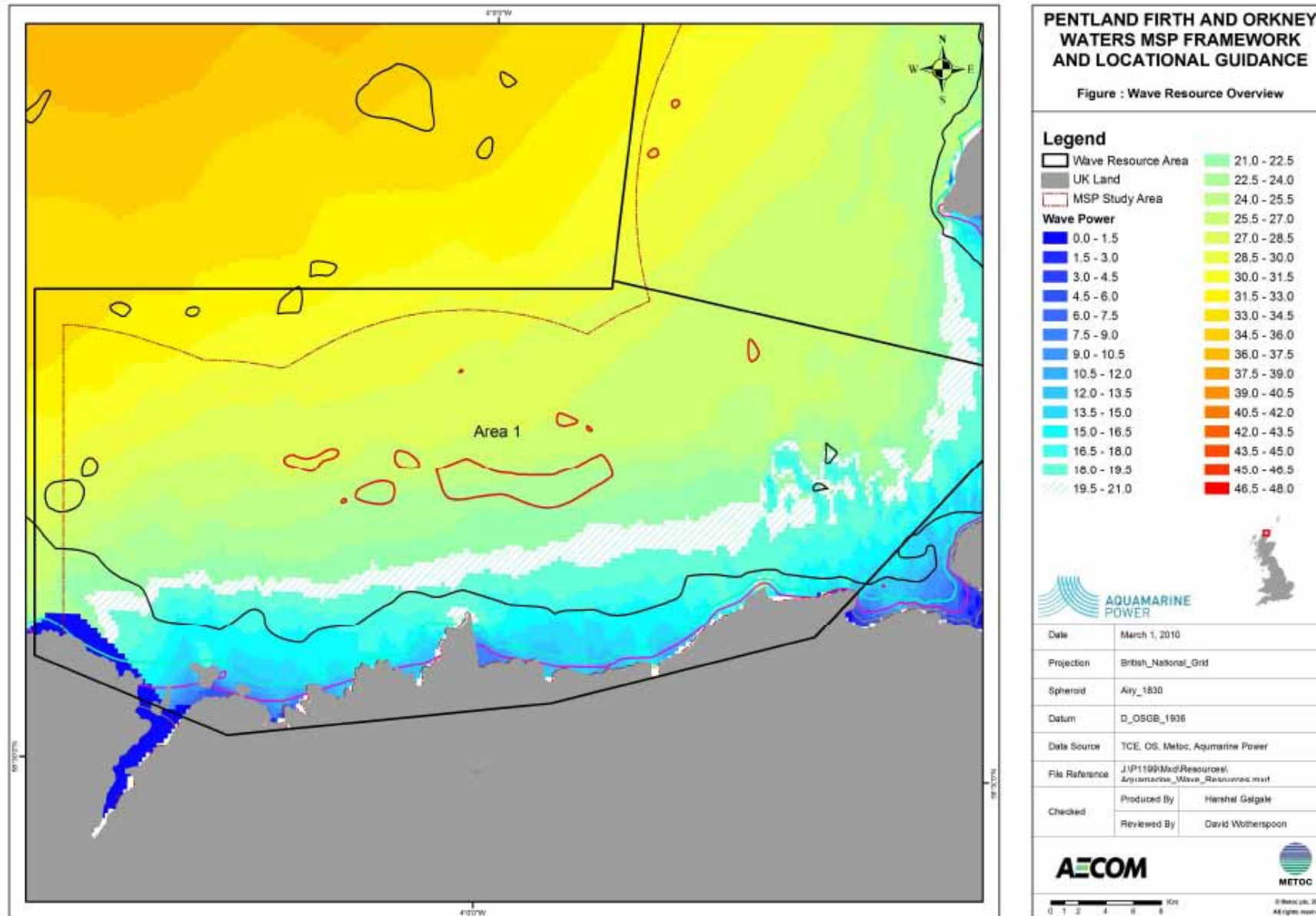
The exposed coastline in this region has suitable wave resources in very close proximity to shore, particularly in areas such as Brough Head and Rousay. Elsewhere, suitable minimum wave resources can be found within 2 to 6 km of the coast.

Wave Area 3 – Westray to North Ronaldsay

The area from Westray to North Ronaldsay has high wave energy potential very close to shore on the exposed west and north coastlines.

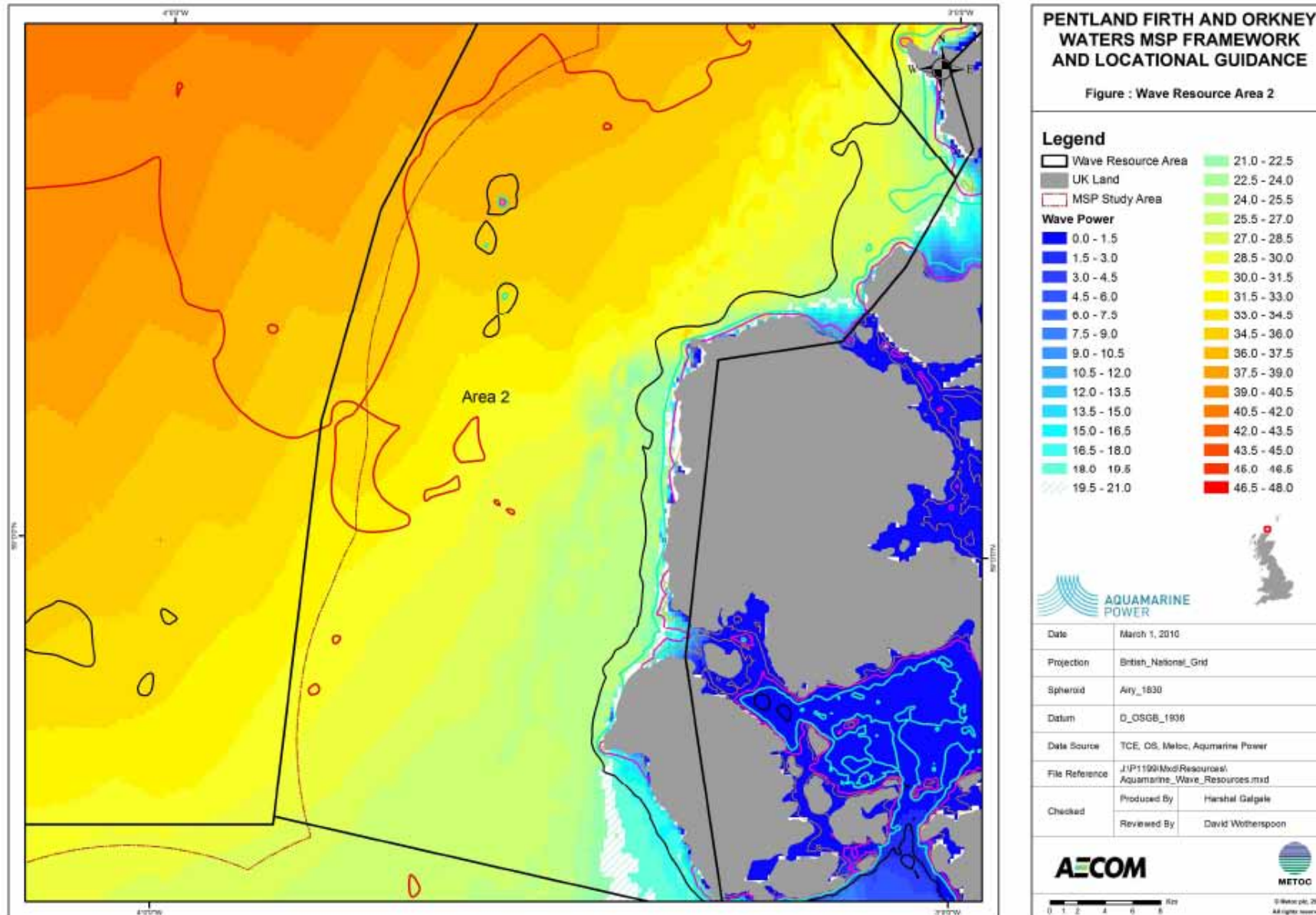
SECTION 2.1: WAVE RESOURCE AREAS

Figure 2.4b: Wave Area 1 – Whiten Head to Thurso



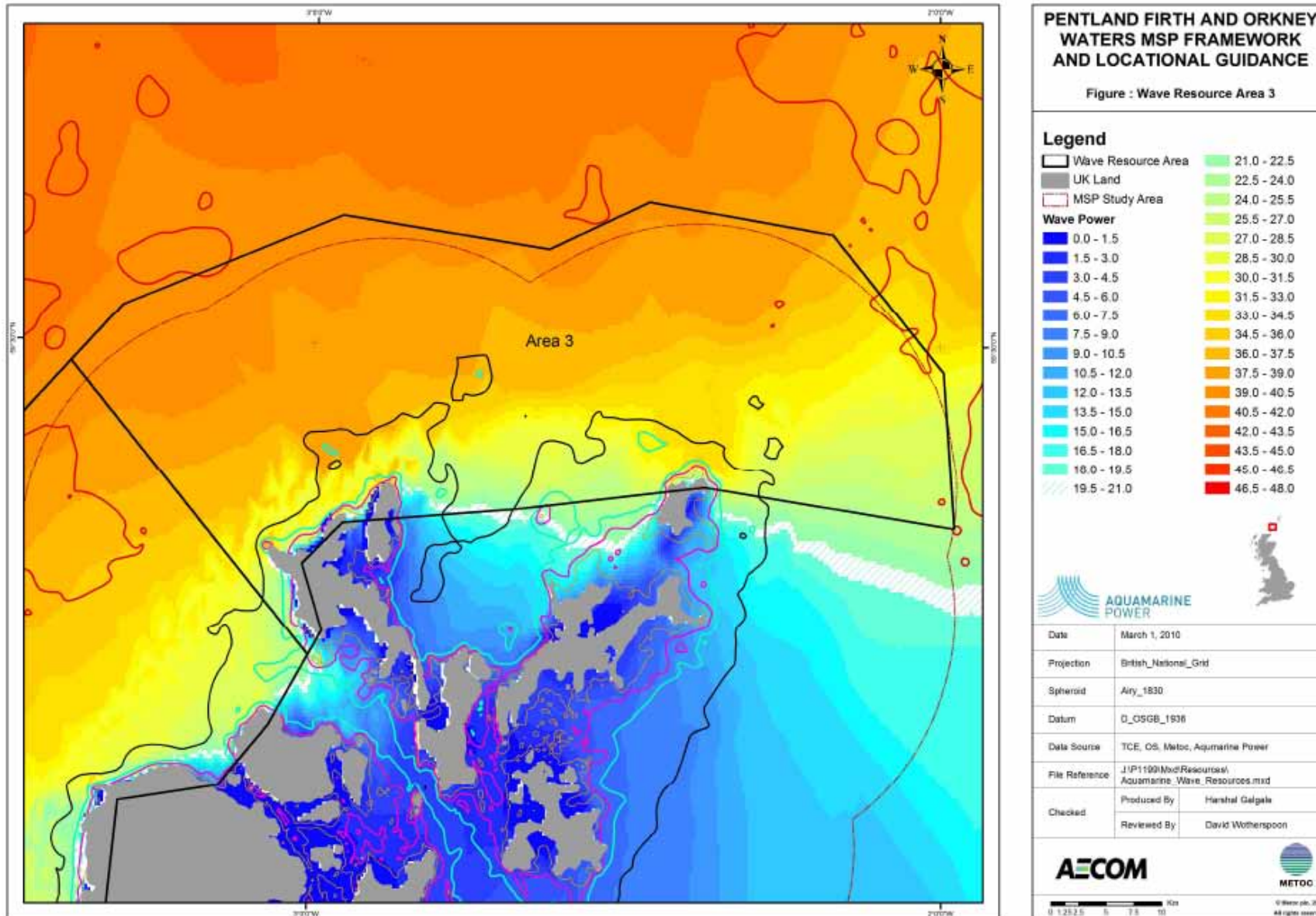
SECTION 2.1: WAVE RESOURCE AREAS

Figure 2.4c: Wave Area 2 –Hoy/Mainland/Rousay



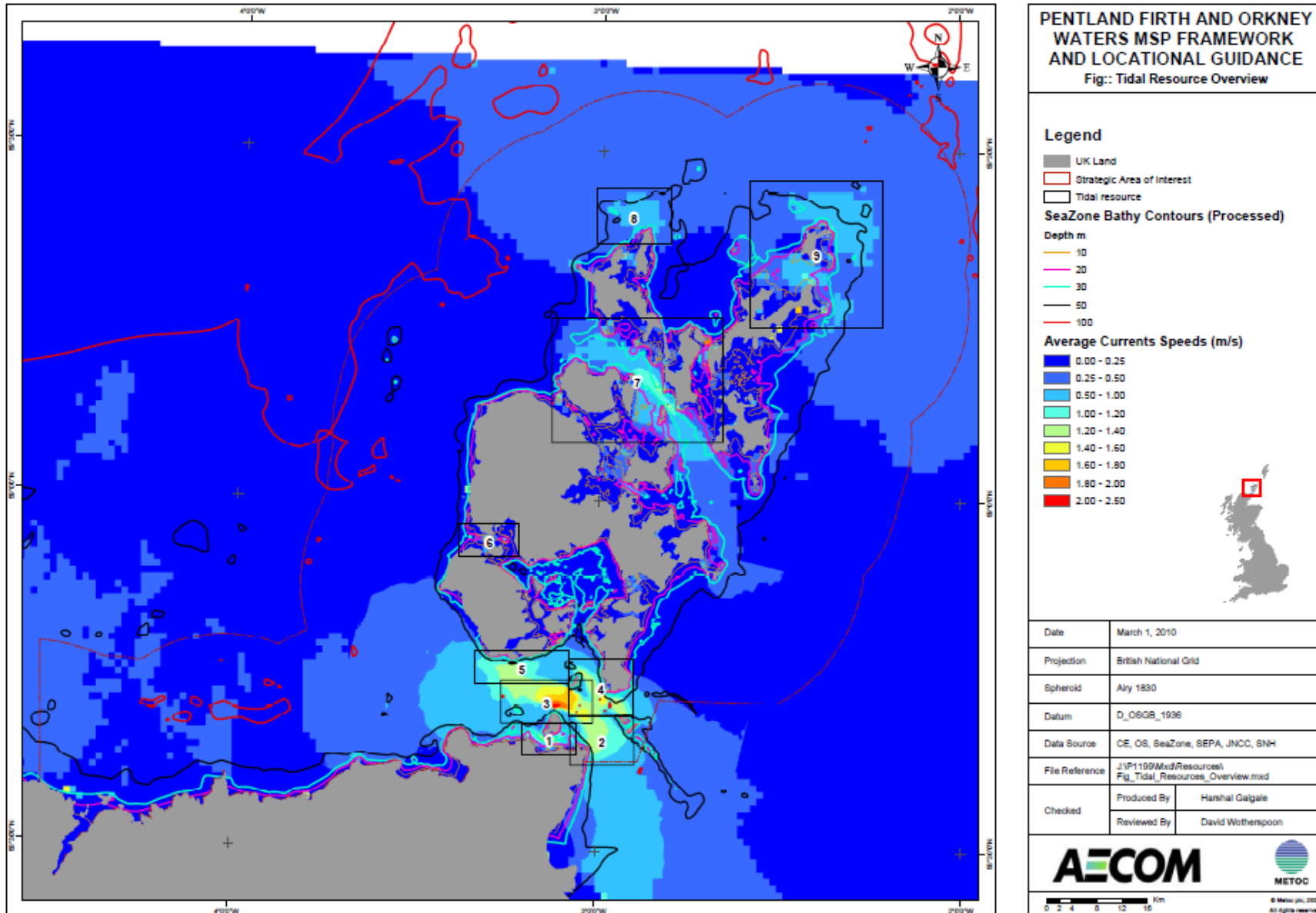
SECTION 2.1: WAVE RESOURCE AREAS

Figure 2.4d: Wave Area 3 – Westray to North Ronaldsay



SECTION 2.2: TIDAL RESOURCE AREAS

Figure 2.5a: Tidal Area Overview



SECTION 2.2: TIDAL RESOURCE AREAS

The tidal resource has been split into nine areas of opportunity as shown in the Figure above. The main resource area is the broad area of the Pentland Firth, which has been separated into five key subareas. These areas should not be regarded as fixed boundaries, but have been developed to assist in breaking down the key resources and constraint issues.

Area 1 – Stroma Sound

Area 2 – Duncansby Head

Area 3 – Pentland Firth Outer Sound

Area 4 – Swona and South Ronaldsay

Area 5 – South Hoy/South Walls

Area 6 – Graemsay (Hoy Sound/Burra Sound)

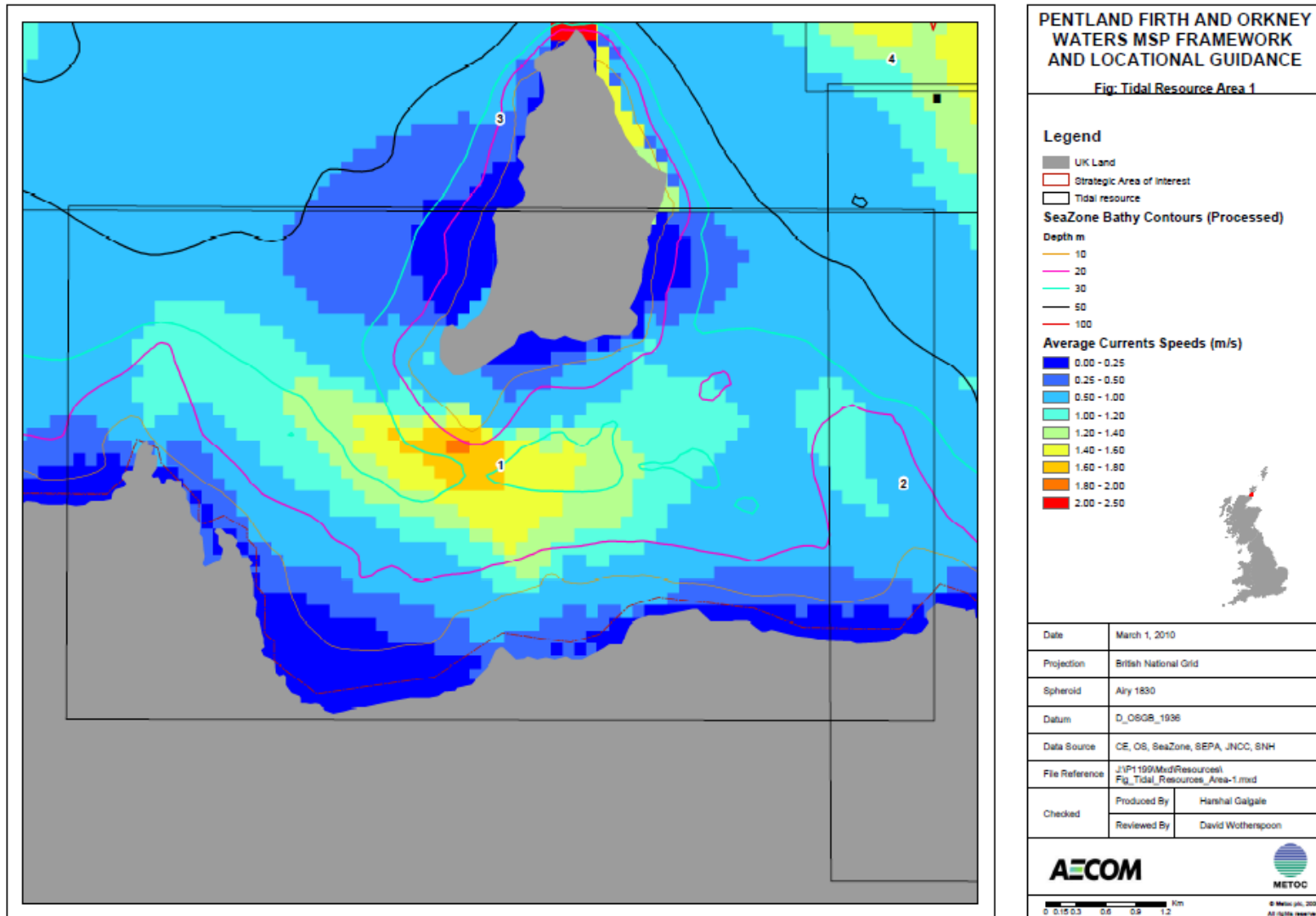
Area 7 – Westray Firth to Stronsay Firth

Area 8 – Papa Westray (Mull Head)

Area 9 – Sanday and North Ronaldsay

SECTION 2.2: TIDAL RESOURCE AREAS

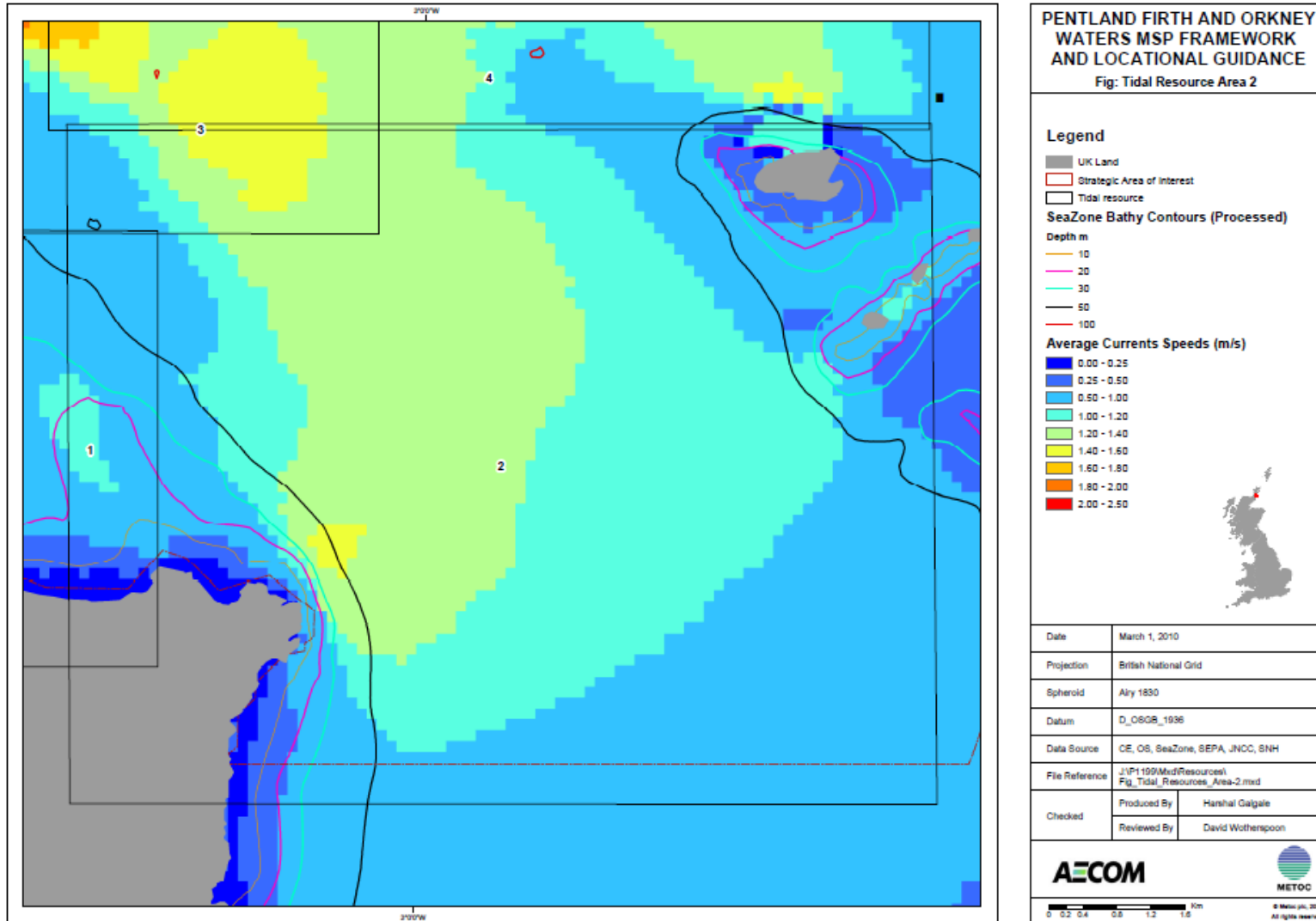
Figure 2.5b: Tidal Area 1 – Stroma Sound



The Inner Sound, south of the Island of Stroma is relatively shallow, reaching a maximum depth of around 35m, but would potentially be suitable for tidal device deployment. The Inner Sound experiences peak spring flows of about 2.5ms^{-1} . There are significant tidal races southwest of the Island of Stroma and further east offshore the Ness of Duncansby on the mainland (the Duncansby Race). The Admiralty Pilot also notes a race forming off Ness of Huna during the east going stream. Eddies form on either side of Stroma during the relevant east or west going main streams.

SECTION 2.2: TIDAL RESOURCE AREAS

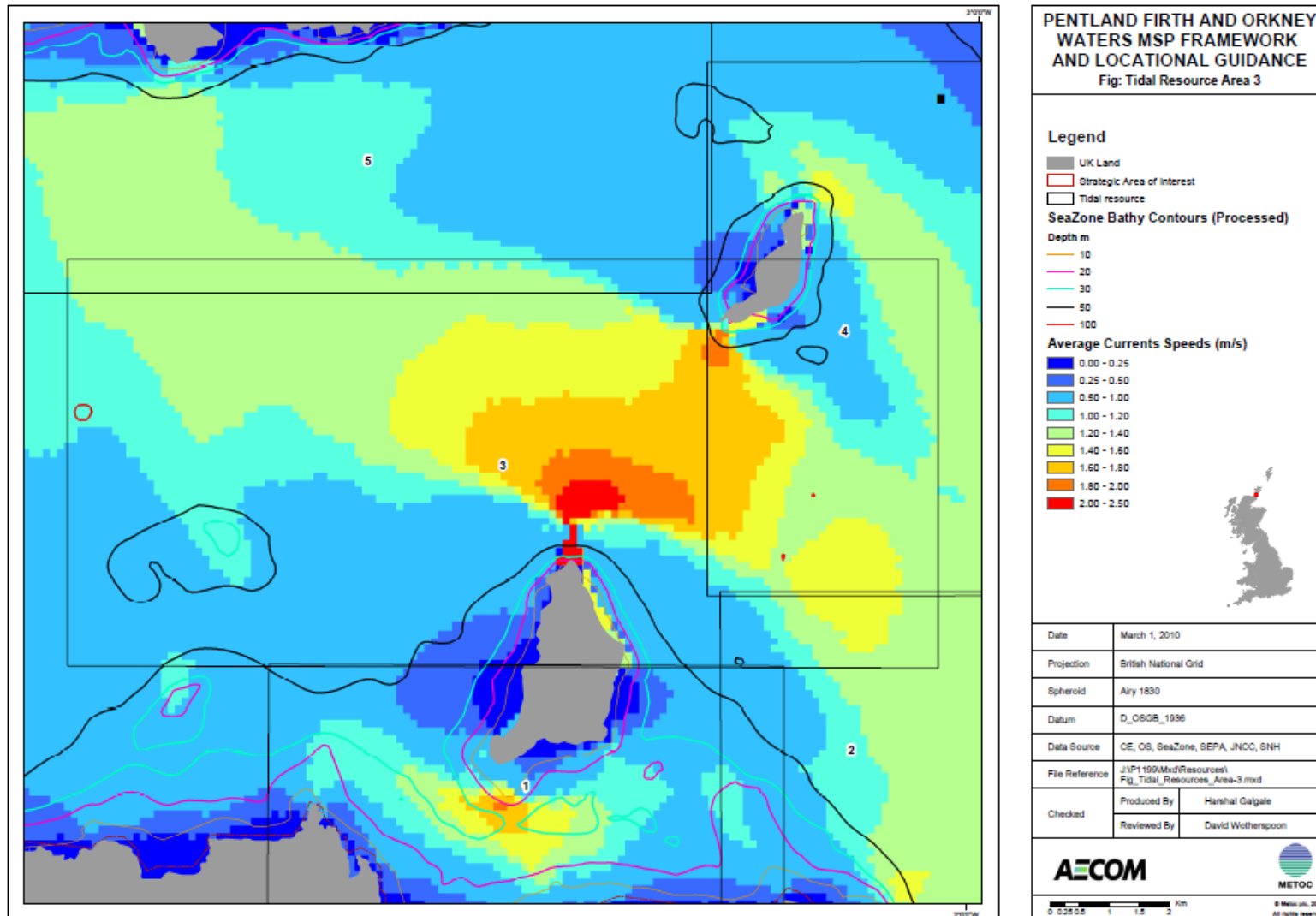
Figure 2.5c: Tidal Area 2 – Duncansby Head



Around Duncansby Head, the seabed quickly falls to 50m and then shelves to around 70m before rising again to the Pentland Skerries. Peak spring rates of 4ms^{-1} are also typical of the channel **between the Pentland Skerries and Duncansby Head** on the mainland, although close in to the Pentland Skerries flows as high as 6ms^{-1} are reported.

SECTION 2.2: TIDAL RESOURCE AREAS

Figure 2.5d: Tidal Area 3 – Pentland Firth Outer Sound

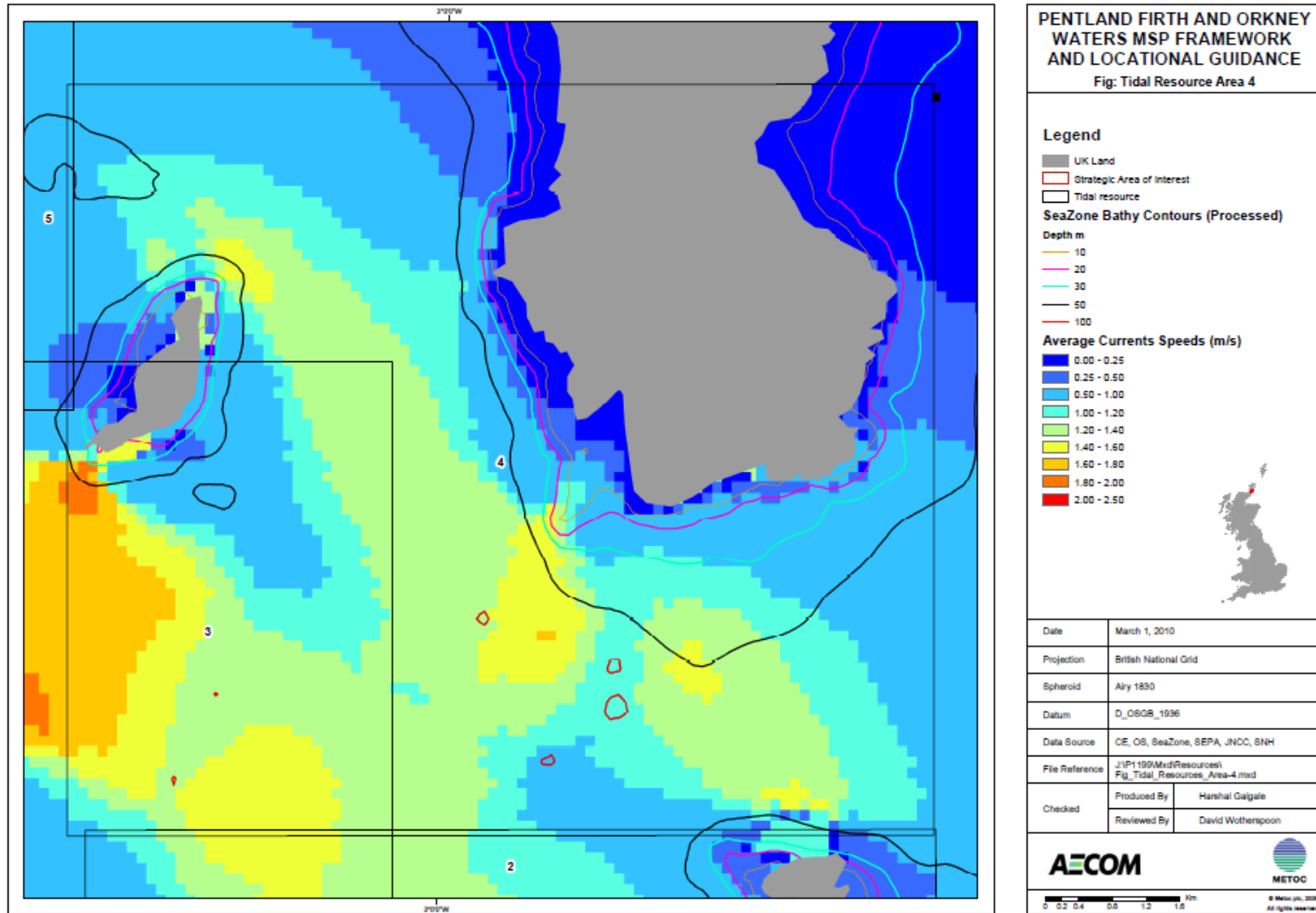


The Outer Sound is a complex area, with strong tidal currents, races and eddies all present. Depths of 60m to 80m are typical. The Admiralty Pilot and charts notes east going streams of up to 9 knots (~4.6 m/s) and west going streams of 8 knots (~4.1 m/s).

The western part of this area contains the Merry Men of Mey tidal race. The Swilkie exists of Silkie Point at the north end of Stroma and races also form at the south (and north) end of Swona. Eddies form either side of both Stroma and Swona, leading to the formation of sandbanks in the lee of the islands.

SECTION 2.2: TIDAL RESOURCE AREAS

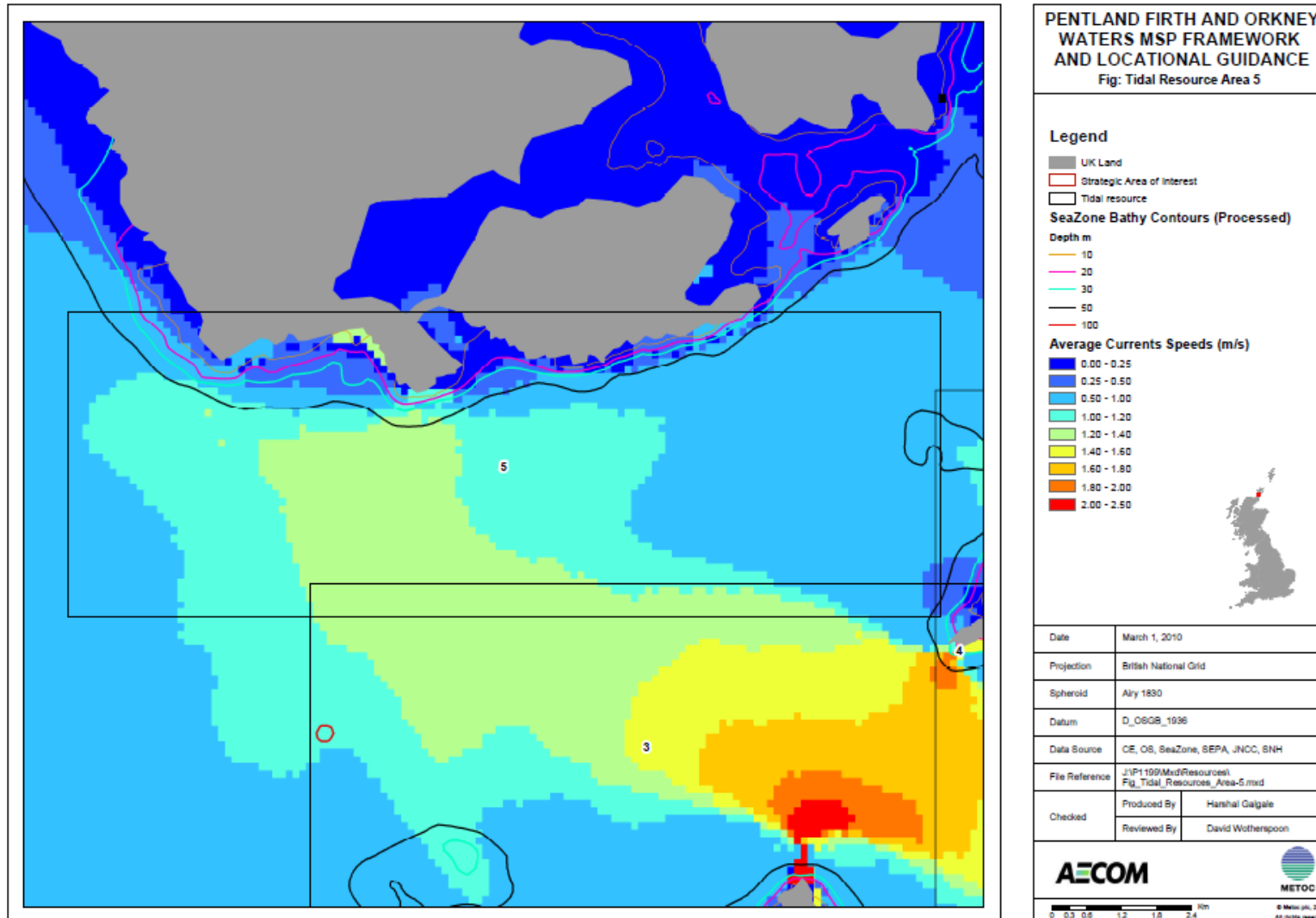
Figure 2.5e: Tidal Area 4 – Swona and South Ronaldsay



The channel between Swona and South Ronaldsay, with general depths of 60m to 70m, has spring rates of 4ms^{-1} on the eastern side. Swona itself causes extensive eddies to its east during the east-going flood tide, and similarly to its west during the ebb. There are also significant tidal races both north and south of the island, as there are to the south of South Ronaldsay.

SECTION 2.2: TIDAL RESOURCE AREAS

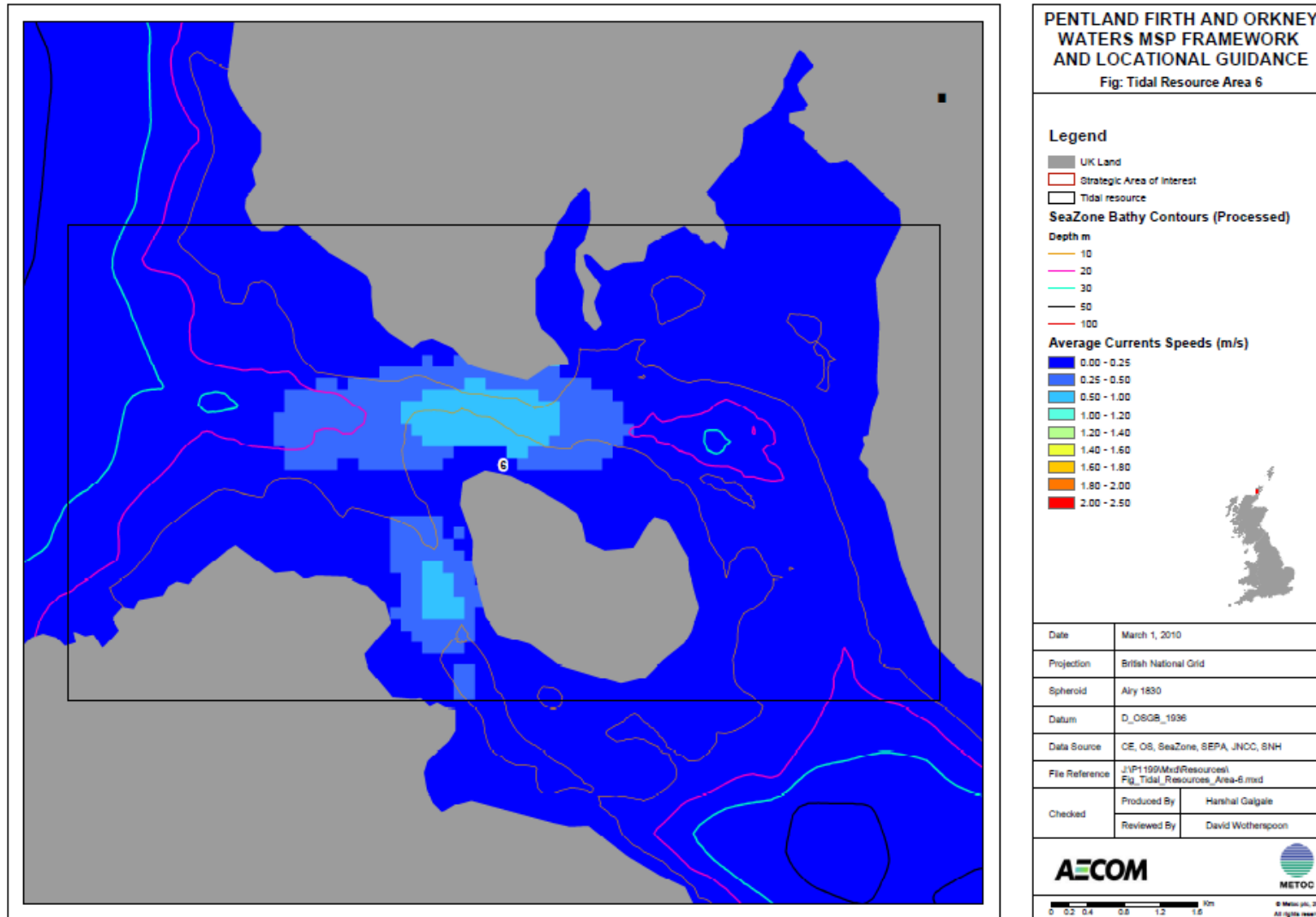
Figure 2.5f: Tidal Area 5 – South Hoy/ South Walls



The area immediately to the south of Hoy and South Walls falls quickly to 50m and then shelves to around 80m. Tidal streams of 3 – 3.5 m/s are present in this areas, with an eddy forming offshore of South Walls.

SECTION 2.2: TIDAL RESOURCE AREAS

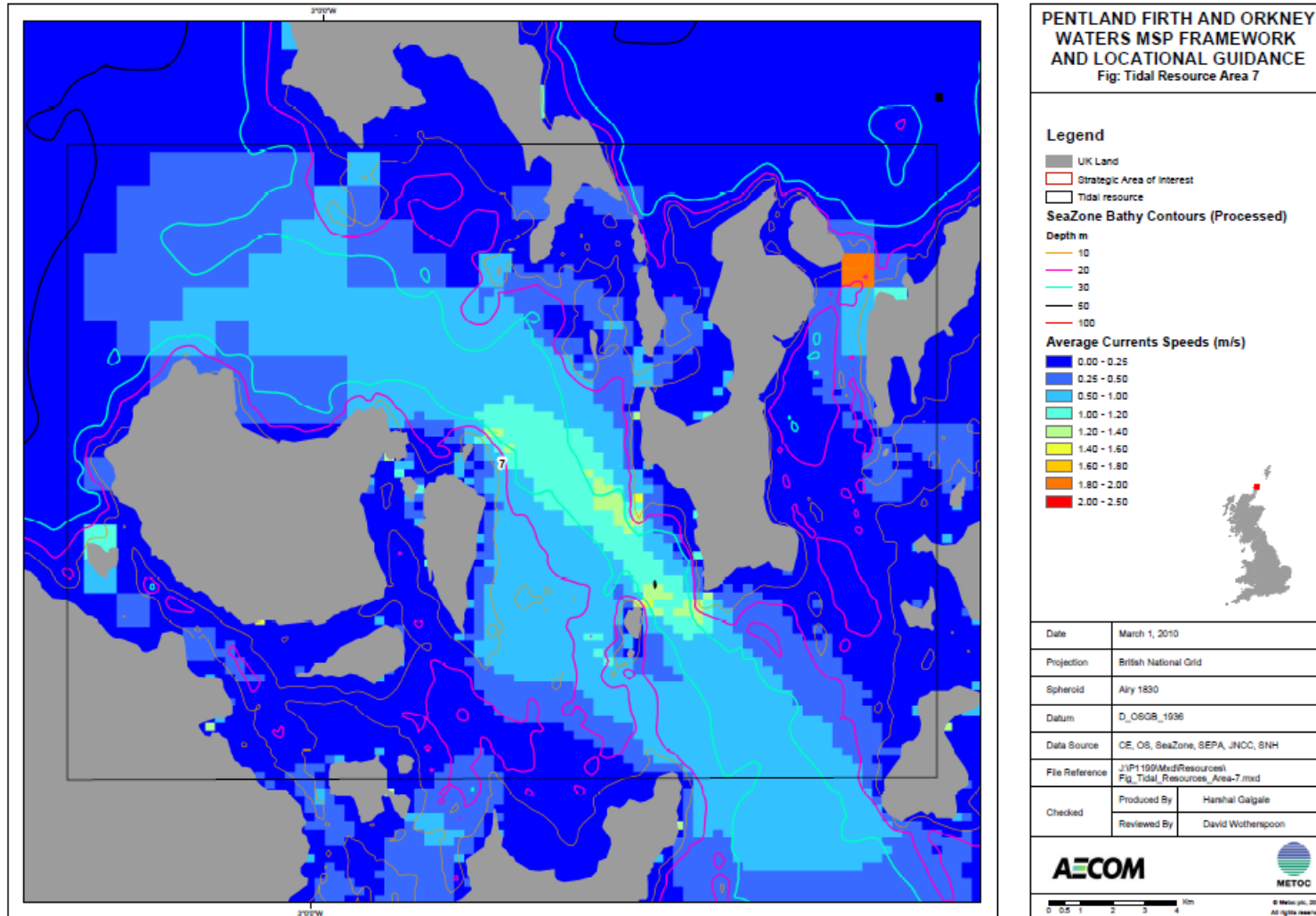
Figure 2.5g: Tidal Area 6 – Graemsay (Hoy Sound/Burra Sound)



In the region of Hoy Mouth, a spring rate of 2 – 2.5 m/s is present in around 25m of water. The incoming stream splits north and south of Graemsay. In the narrows north of Graemsay, a spring rate of 4.4m/s exists (2.5m/s on neaps) in shallow waters of around 10m. Burra Sound has streams of approximately 2.3 to 2.8 m/s , but again in shallow waters of around 10m. This area is unlikely to be a significant opportunity for presently considered technologies, given the shallow depths present, but may be considered for emerging technologies.

SECTION 2.2: TIDAL RESOURCE AREAS

Figure 2.5h: Tidal Area 7 – Westray Firth to Stronsay Firth



The channels between the northern Orkney islands present a number of opportunities for varying scales of tidal stream development. The Fall of Warness contains the EMEC tidal test site.

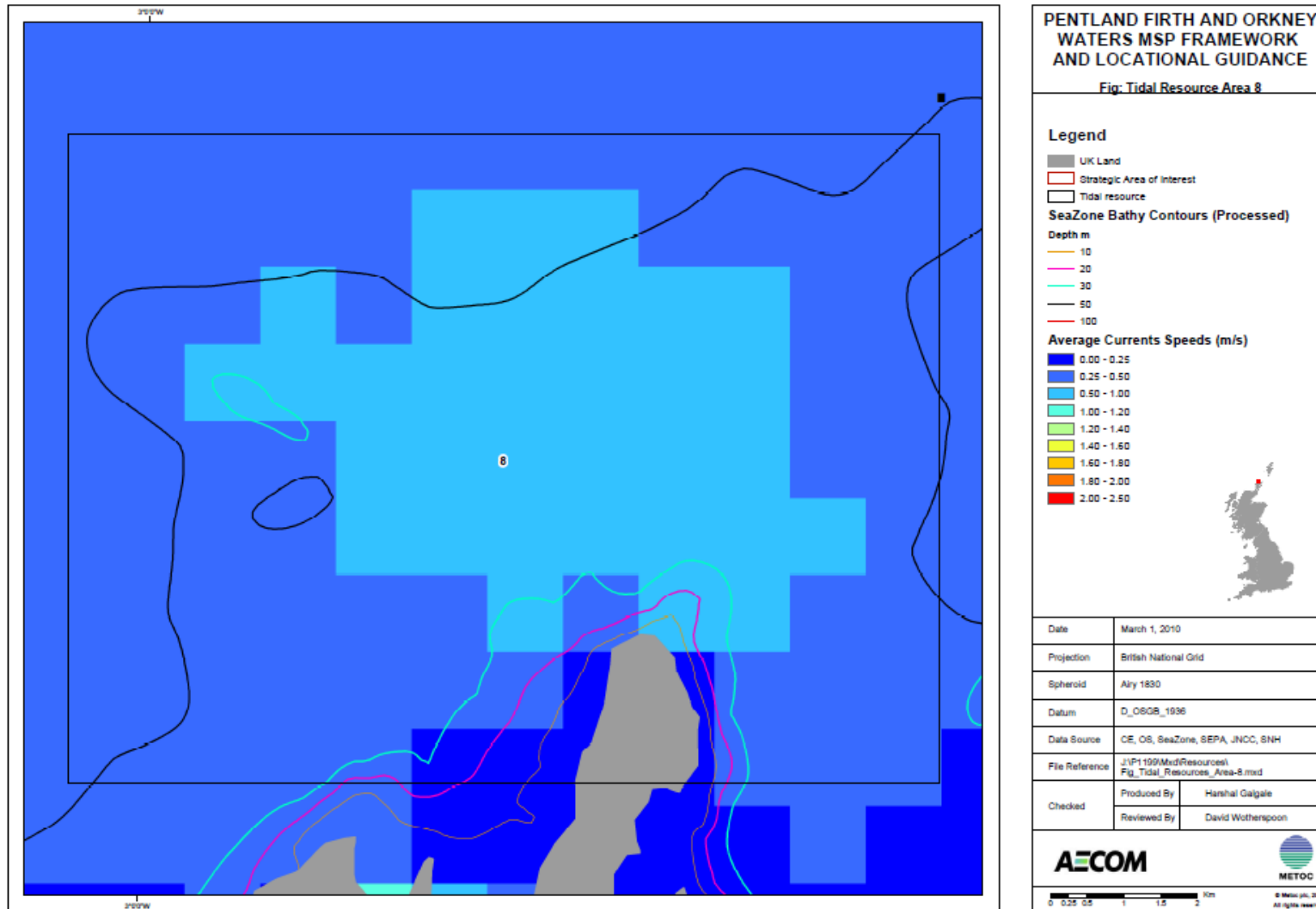
Strong tidal streams exist off War Ness at the south of Eday, but are likely to be variable in direction as different channel streams dominate at different stages of the tide. Strong tidal streams of around 3m/s exist in the narrows at the north end of Eday Sound/ south end of Lashy Sound, although the tidal diamond in this area notes relatively weak neap tide currents, potentially making it unsuitable for commercial scale developments due to the asymmetry in potential power production.

The tidal diamond information for Westray Firth generally confirms the modelled information, with the central channel providing the main opportunity with peak spring rates of around 2.6m/s and peak neap rates of 1.1m/s between Firs Ness on Eday and Kili Holm off Eglisay. Between War Ness and Muckle Green Holm the peak spring rate is around 3.7 m/s and the peak neap

rate is 1.4 m/s. Further north in the Westray Firth, the Rull Rost tidal race forms during both tidal streams.

SECTION 2.2: TIDAL RESOURCE AREAS

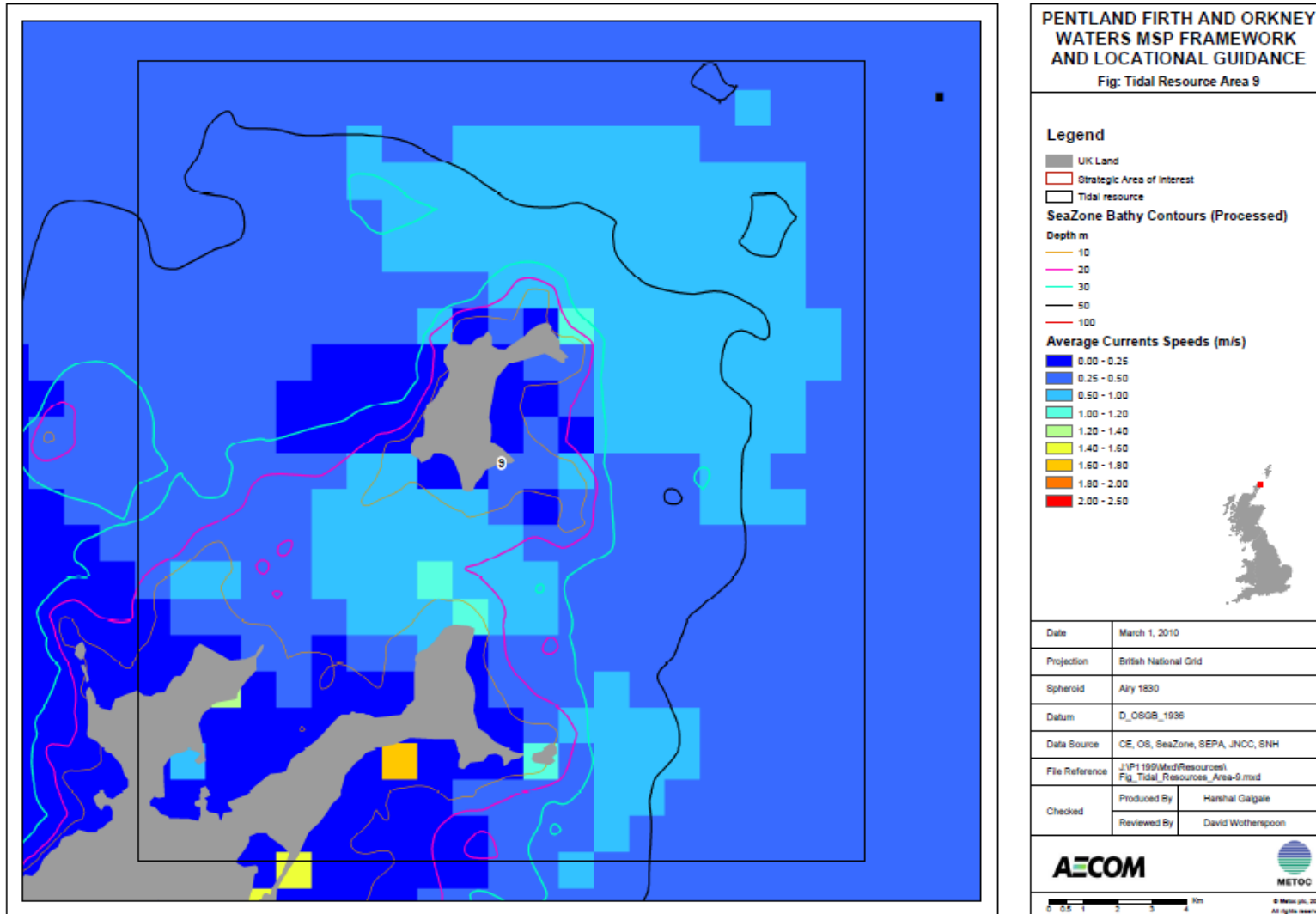
Figure 2.5i: Tidal Area 8 – Papa Westray (Mull Head)



The area immediately off Mull Head drops quickly to 30m before shelving more gently to 50m. The tidal stream close inshore forms a race, with a spring rate of 2.5m/s noted in the area. Again, this may be borderline for present commercial technologies, but could be of interest for emerging technologies.

SECTION 2.2: TIDAL RESOURCE AREAS

Figure 2.5j: Tidal Area 9 – Sanday and North Ronaldsay



The North Ronaldsay Firth is relatively shallow at 10 to 15m and unlikely to be of interest to present tidal steam technologies. Little information exists on the strength of tidal currents in the area and the existing models are not sufficiently resolved or local reliant to be sufficiently accurate, and presently indicate that the resource is marginal for commercial scale development. However, there is sufficient weight of evidence to identify areas off some of the headlands to be of potential interest, subject to confirmation of the resource.

At the north end of Sanday at Start Point, a tidal race forms with the southeast going stream in depths of 25 to 30m. A further race forms at the entrance to the Firth off Tofts Ness in 20m to 30m of water. At the north end of North Ronaldsay, a further race forms off Dennis Head, where the seabed quickly drops to 30m before shelving to 50m, where a spring stream of 2.5m/s is noted. The Admiralty Pilot also notes a spring rate of 3m/s off Seal Skerry.

SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

This section of the RLG provides a summary of wave and tidal device characteristics. It also provides information on associated infrastructure.

The range of technologies currently under development continues to expand. It is not intended to provide a full overview here, as a number of previous summaries exist. The European Marine Energy Centre (EMEC) provide a summary of wave and tidal device types and methods of fixing to the seabed, see http://www.emec.org.uk/wave_energy_devices.asp and http://www.emec.org.uk/tidal_devices.asp.

A summary of devices and operating constraints has also been published in the Scoping report for the wave and tidal SEA for Scotland and can be viewed at <http://www.seaenergyscotland.net/Data/20060223/Final%20Scoping%20Report%20V2%20Feb%2006.pdf>

A more recent update has also been published in Northern Ireland's marine renewables SEA and can be downloaded from <http://www.offshoreenergyini.co.uk/Data/Final%20Scoping%20Report%20April%202009.pdf>

The table below provides an overview of developing device types. The table is not meant to be an exhaustive list of all technologies under development, but provides an indication of stages of development.

SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

Table 3.1: Overview of Developing Wave and Tidal Devices

Developer	Device Name Tidal or Wave	Foundation Type			Fully Submerged	Development Stage	Operational Water Depth Approx.
		Gravity Base	Piled	Moored			
Open Hydro	Open Hydro (Tidal)	Yes			Yes	250kW Prototype installed and grid connected at EMEC. Larger device installed in Bay of Fundy late 2009.	>20m
Voith Hydro	Sea Turtle (Tidal)	Yes	Yes		Yes	It is understood that a demonstration model programmed for installation in 3rd Qtr 2009	40m
Swan Turbines	Cygnets (Tidal)	Yes			Yes	350kW demonstrator under development	25m
Tidal Generation Limited	DEEP-Gen (Tidal)	Yes	Yes		Yes	Device trials planned at EMEC in 2009.	30m
Lunar Energy	RTT (Tidal)	Yes			Yes	1/3rd scale demonstrator, believed to be installed at EMEC 2010	40m
Aquamarine	Oyster (Wave)	Yes			No	Prototype installed at EMEC mid-late 2009.	> 10m
Marine Current Turbines	SeaGen (Tidal)		Yes		No	2008 1.2MW Sea Gen installed 2003 Seaflow prototype installed	20-25m
ScotRenewables	SRTT (Tidal)			Yes	No	Scale model trailed. Understood that a prototype is planned at EMEC 2010	Moored >15m
SMD Hydrovision	TidEi (Tidal)			Yes	Yes	1/10th Scale model trailed. Expecting to install 1MW unit at EMEC 2009	>30m

SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

Developer	Device Name Tidal or Wave	Foundation Type			Fully Submerged	Development Stage	Operational Water Depth Approx.
		Gravity Base	Piled	Moored			
Hammerfest Strom	HS1000 (Tidal)	Yes			Yes	300kW prototype installed, grid connected 2003 in Norway. Development plans with Scottish Power	>25m
Pulse Generation Limited	Pulse Tidal (Tidal)		Yes		No	150kW prototype which we believe is currently being trailed.	Shallow Water
Ocean Flow Energy	Eloped (Tidal)			Yes	No	It is understood that a 1/10th scale unit is under test in tidal stream. Has investment from Aquamarine Power.	Moored > 20m
Pelamis Wave Power	Pelamis (Wave)			Yes	No	Prototype devices deployed. Small array installed off Portugal and further arrays planned	Moored > 40m
AWS Ocean Energy	Archimedes Waveswing (Wave)			Yes	No (6m below surface)	Plan to deploy a 250kW demonstrator in 2010 with commercial roll-out to follow by 2011.	40m -100m
ORECon	MRC (Wave)			Yes	No	Awarded a berth at SWRDA's Wave Hub facility	Not known
Ocean Power Technologies	PowerBuoy (Wave)			Yes	No	Has undergone ocean testing since 2004 in US and development underway off Spain and has plans at EMEC and Wave Hub.	Not confirmed, >25m
Atlantis Resources	Solon & AK-1000 (Tidal)	Yes			Yes		>30m
Wavebob	Wavebob (Wave)			Yes	No	Developments planning in Ireland. JV with Vattenfall for site developments	Not confirmed, >70m

SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

CABLE INFRASTRUCTURE

To develop a full commercial array, the devices will be placed into an area to make best use of the bathymetry and energy capture conditions, whilst recognising environmental issues and potential interactions with other users of the area.

Cables will run between the individual devices within the array and one or more export cables will run back to shore, possibly via an offshore transformer platform where multiple arrays are close enough together to take advantage of economies of scale.

Cable installation works will create a temporary issue for other sea users. Given the seabed in the area and the high tidal currents being sought out, it is likely that the cables inter-array cables will be surface laid and the main export cables may either be surface laid (and pinned to the seabed or otherwise protected) or directionally drilled. The installed export cable potential interactions with fishing activities will need to be assessed on a case by case basis, as snagging of fishing gear may be an issue along with potential damage to the cable.

A number of the parameters will be considered when selecting a cable landing area listed in the table below, with preferred and “acceptable” conditions

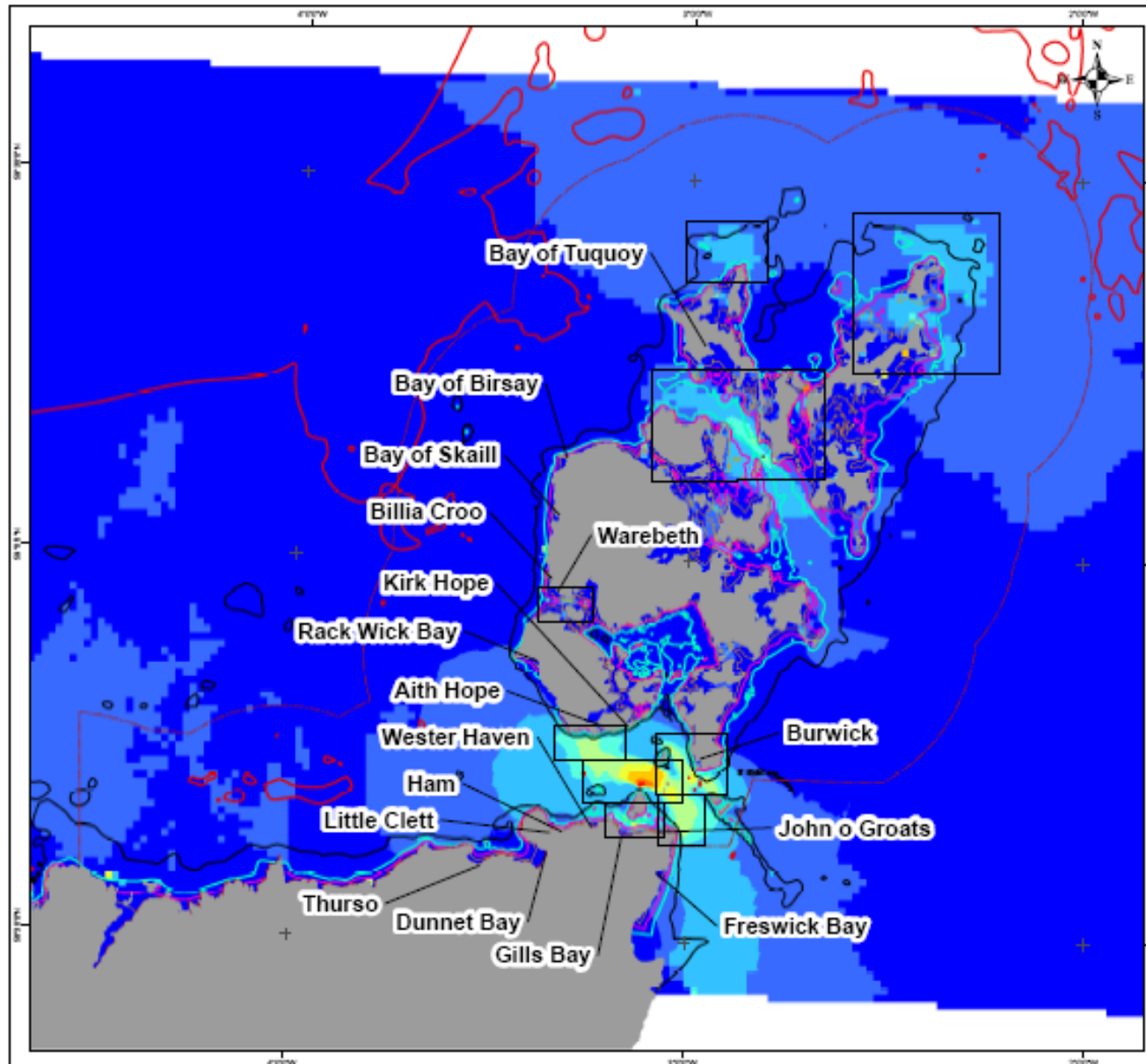
The figure below highlights locations from a first pass of observations that meet either the preferred or acceptable beach landing criteria. There may be other locations, particularly in the Westray, Eday, Sanday Stronsay areas which have not been examined in detail, which are likely to be acceptable cable landing areas, as evidenced by the existing inter-island cable network.

Table 3.2: Preferred and Acceptable Cable Landing Points

Parameter	Preferred	Acceptable
Beach & Seabed geology & sedimentology	Gently shelving beach & approaches, > 2m sediment cover. Stable beach level.	Gently shelving beach, < 1m sediment cover, pebbles & small boulders if they can be excavated, rock seabed providing profile will not cause cable suspensions. Existing slipway if it offers opportunity as cable way.
Local Weather Patterns & Tides/Currents	Sheltered from prevailing weather, currents < 1knt	Partial shelter from prevailing weather, currents < 2knts
Fishing/anchoring & other risks	No inshore fishing or anchoring	Inshore fixed gear fishing, yacht anchorage, fish farming if clear of cable route.
Proximity & diversity for other cables/pipelines	No cables or pipelines in area	Landing offers sufficient space to achieve adequate separation, to be defined, on a case by case basis.
Access for cable vessel/Barge	10m water depth contour < 500m from MLW mark. Approaches clear of all dangers	10m depth contour < 1000m from MLW mark, off shore dangers with sufficient sea room to allow safe vessel access.
Access for land cable & beach plant	Access via A roads, no improvements needed, hard standing available for plant.	Access via B road or track, with ability to upgrade if required. Space available to build hard standing.
Cable engineering & protection requirements	Cable can be direct buried on beach and off shore	Cable can be protected with split pipe & pinned to seabed if required
Existing power infrastructure	Landing <10km from existing power infrastructure	Landing > 10km from existing power infrastructure, with viable route to build link.

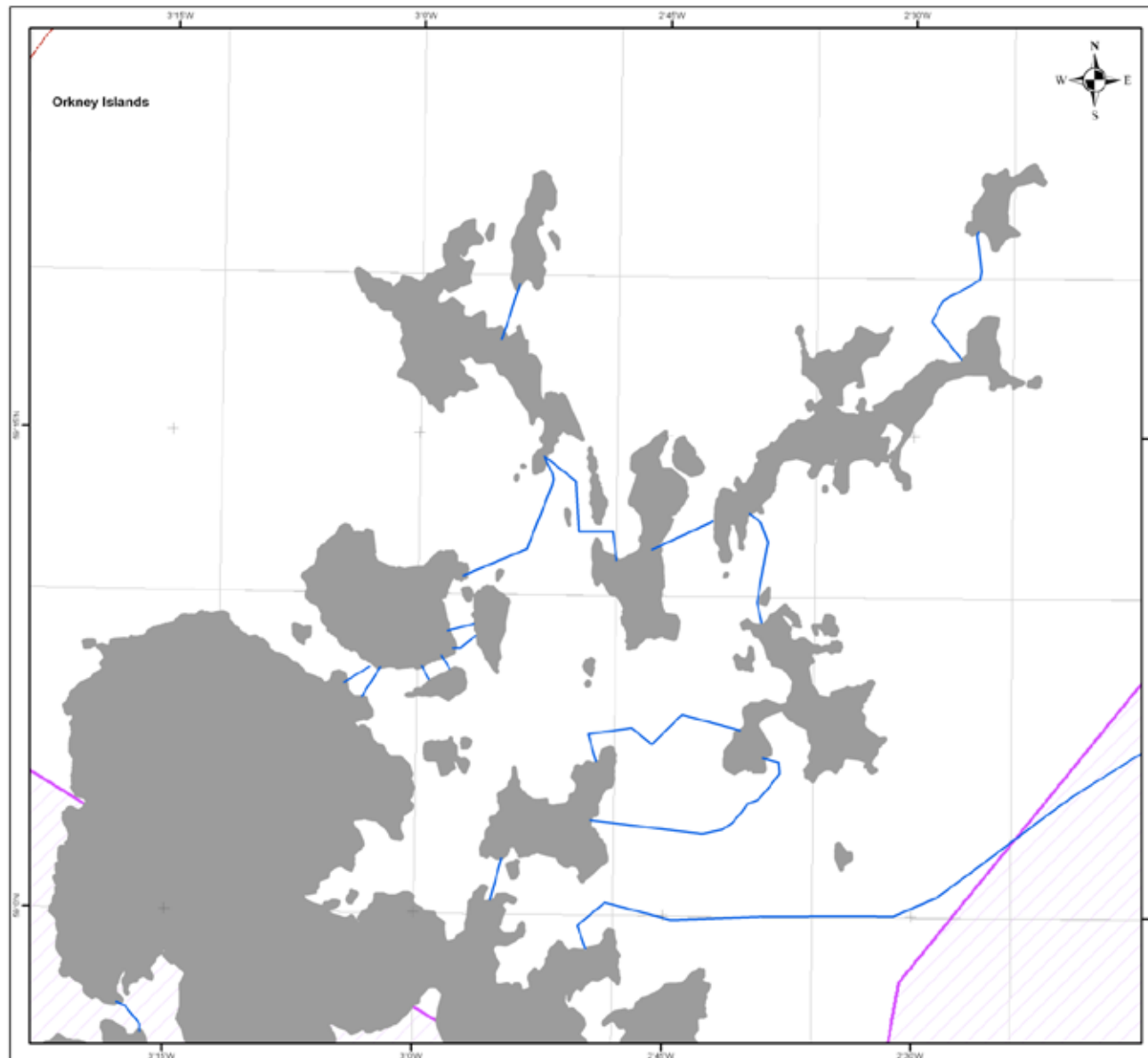
SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

Figure 3.1: Potential cable landing points



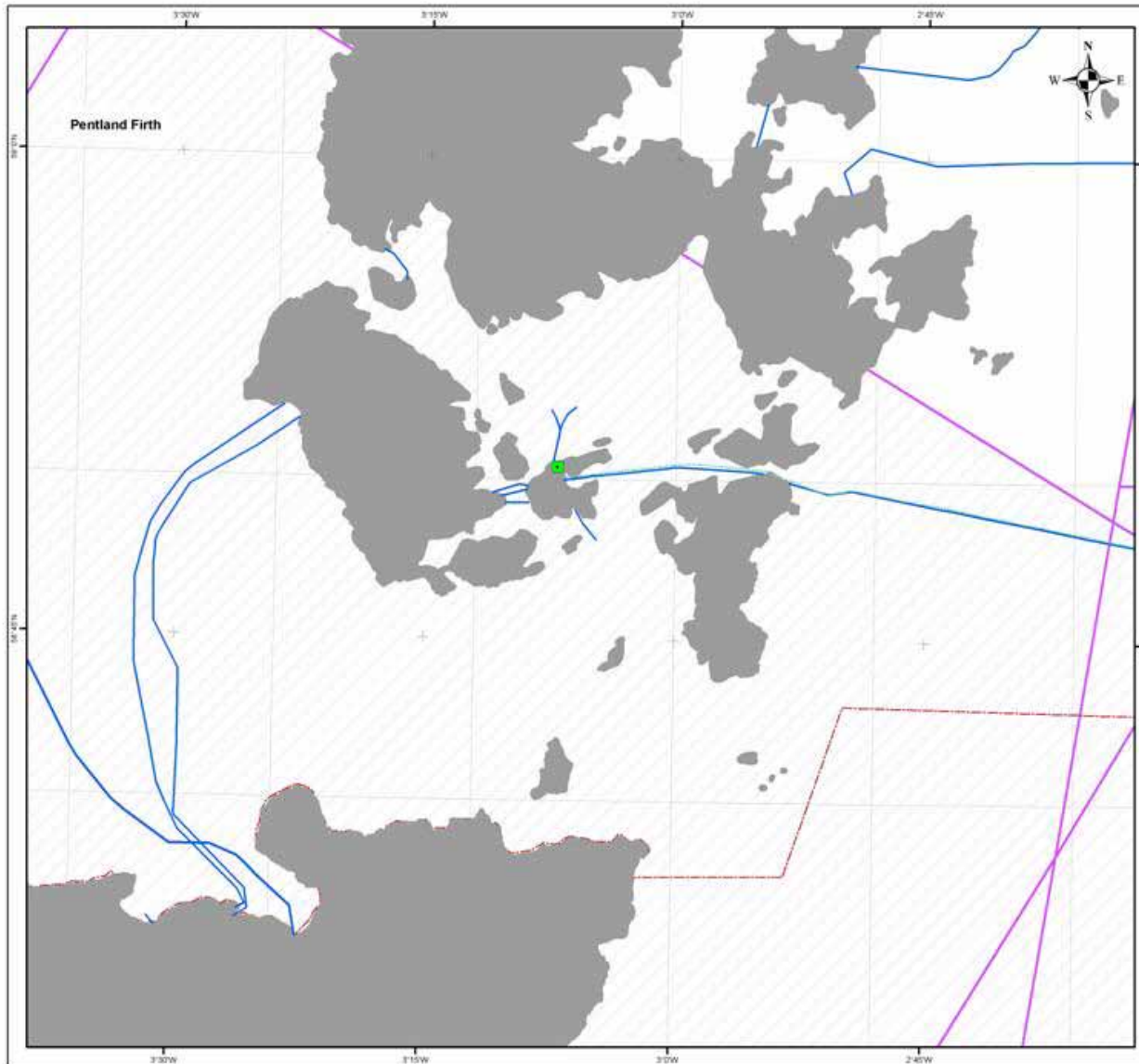
SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

Figure 3.2: Existing cables and pipelines – Orkney



SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

Figure 3.3: Existing cables and pipelines – Caithness and Orkney



SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

The existing weakness of the grid throughout Scotland to convey renewable energy generation to demand centres has been well recognised. There are a number of initiatives underway to plan grid development both nationally and also specifically for the Caithness and Orkney Islands areas.

At a national level the Beaully-Denny has been approved, and plans are progressing for a number of land based reinforcements and subsea interconnectors.

Amongst the initiatives already underway, the Electricity Network Strategy Group (ENSG) has considered the Orkney and Caithness grid reinforcements together with national levels plans for the transmission system. National Planning Framework 2 also included electricity grid reinforcements, including upgrades on the Beaully to Dounreay and Beaully to Keith transmission lines and new sub-sea cable links between Orkney, the Outer Hebrides, the Shetland Islands and the mainland.

Scottish Hydro Electric Transmission Limited (SHETL), part of the Scottish & Southern Energy (SSE) and National Grid (NG) have been examining plans for a subsea interconnector from Orkney to the Scottish mainland, and options for grid reinforcements within the Orkney Islands and for the Caithness area.

The key issue remaining is to align the timescales for wave and tidal energy developments and the provision of the required grid reinforcements. National Grid and SHETL are discussing the emerging plans with the Pentland Firth developers, incorporating wave and tidal developers in the Firth and Orkney, with these aims in mind.

SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

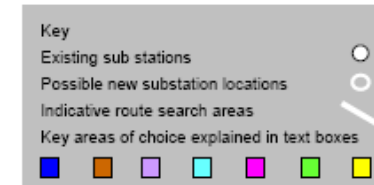
Diagram 3.1: Connection Options: Orkney

Connection Options: Orkney

Scottish Hydro-Electric
Transmission Limited
Potential Orkney
Connection options



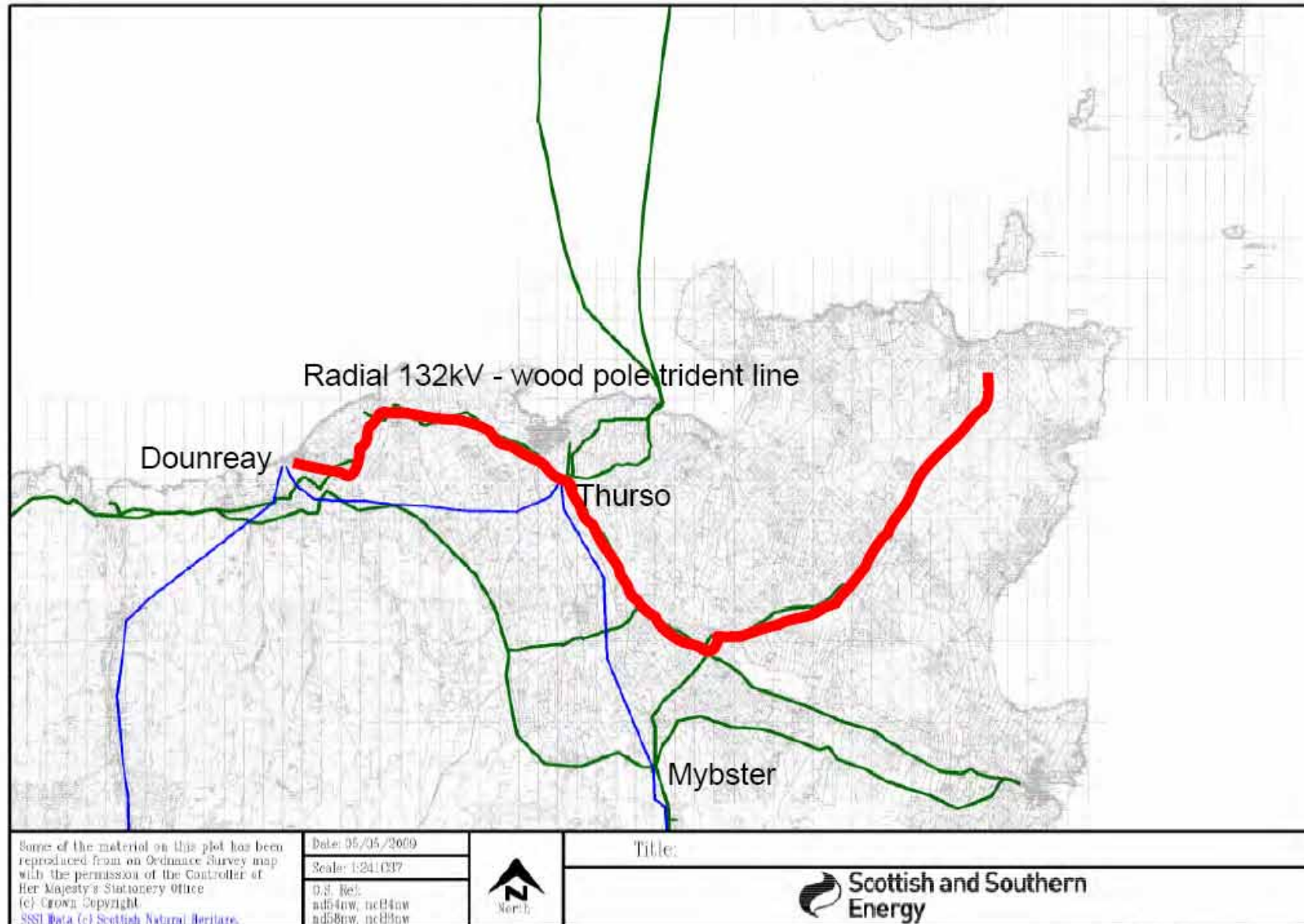
Figure 9.1 Map showing the key strategic choices that the route and site selection process has considered



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SECTION 3: WAVE AND TIDAL DEVICE CHARACTERISTICS AND INFRASTRUCTURE

Figure 3.4: Indicative transmission reinforcements – Dounreay to Gills Bay



SECTION 4: INTERACTION WITH OTHER SECTORS (SHIPPING AND FISHING)

OTHER SECTORS

Section 4 of the MSP Framework provided a summary of interactions across all marine sectors. This section provides an overview of the potential interactions between marine renewables and two particular sectors: shipping and fishing.

Key interactions are expected to take place with the **fishing** industry, **shipping** and navigation and the **natural environment**. Other sectors where interaction is likely, but at an anticipated lesser scale will be developed later as the MSP develops over time. The potential interactions with the natural environment are generally described in the zone specific guidance sections. A generalised description of potential interactions with fishing and shipping is provided here, together with further information in the zone specific guidance. Environmental topics have been covered in the Scottish Government's wave & tidal SEA. Key environmental topics are highlighted in the zone specific guidance sections.

Fishing

It has previously been stated that It is not the purpose of the MSP to control the commercial or operational activities of the fishing industry e.g. quotas. The MSP will influence the location of development and how fishing interests should be taken into account in decisions making. **The fishing industry plays a significant part in the local economy.** The Pentland Firth and waters around Orkney are also regularly used by local fishing fleets that are either passing through the area to access key commercial fishing grounds or land at local harbours e.g. Scrabster, Stromness or Kirkwall.

This section does not cover recreational fishing activity, sea-angling, freshwater fishing, nor does it cover fish farming.

Commercial fishing activity may be displaced by the location of marine renewable energy developments. The major commercial demersal and pelagic fishing takes place in grounds generally outwith the presently considered 12 nautical mile limit.

Smaller vessels operating for crab, lobster and scallops within nearshore areas will be more directly affected.

The effects of displacement will have to be considered alongside potential beneficial effects. Fishing vessels, large and small, will also be affected in terms of

navigation interest in a similar manner to major shipping by the location of marine energy developments.

The inshore areas used for common whelk, crab and lobster fishing and the offshore areas used for pelagic and demersal fishing have been mapped at an indicative level through consultation with the local fishermen's associations. The map is marked up for the following:

Blue = trawl or seine fishing for demersal or pelagic species

Brown = common whelks and velvets – creel fishing

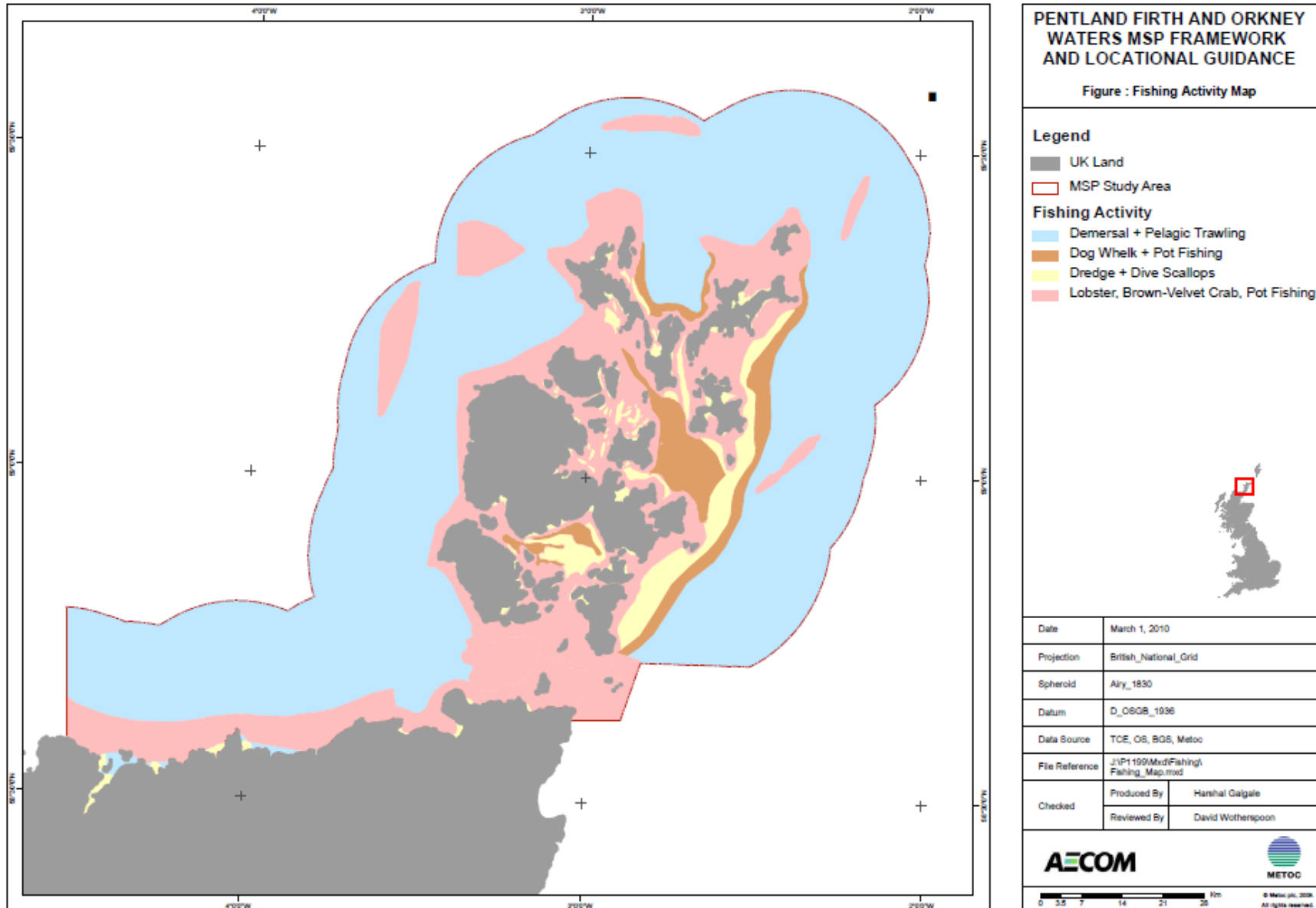
Pink = lobsters, partans and velvets - creel fishing

Yellow = razorfish, scallops, winkles etc, gathered by hand (dive) or dredged.

As well as the activities mapped, there is a small nephrops prawn fishery in Scapa Flow mainly on the scallop ground to the south of the Barrel of Butter.

SECTION 4: INTERACTION WITH OTHER SECTORS - FISHING

Figure 4.1: Indicative Fishing Map



SECTION 4: INTERACTION WITH OTHER SECTORS - FISHING

The lobster ground covers a lot of the potential tidal and nearshore wave sites. It is understood that all this ground is fished, though fishing in the most energetic tidal areas > than around 5 knots is restricted to neap tides.

Contacts for fishing interests include:

Scottish Fishing Federation

Orkney Creel Fishermen's Organisation

Orkney Fisheries Association

Orkney Fishermen Society

Scottish White Fish Association

Fishermen's Association Ltd

Highland Inshore Fisheries Association

Mallaig and North West Fisheries

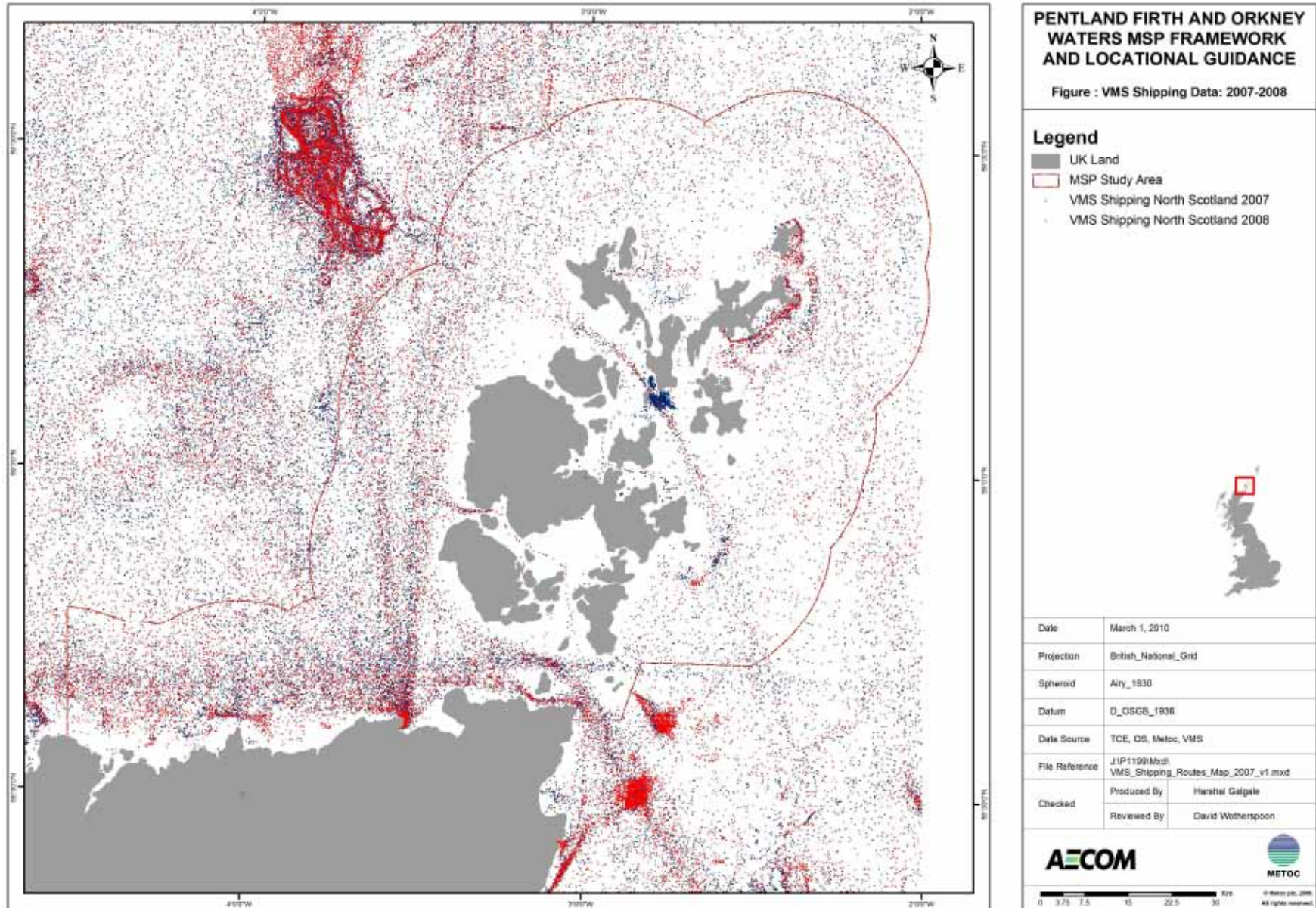
Scottish Fisheries Protection Agency

No Inshore Fisheries Group has yet been set up for the North Coast and Orkney areas.

In addition to the inshore fishing activity mapped with the assistance of the local associations, movements of vessels over 15m in length has also been mapped.

SECTION 4 INTERACTION WITH OTHER SECTORS - FISHING

Figure 4.2: Map of Vessel Movements 2007 and 2008



SECTION 4: INTERACTION WITH OTHER SECTORS - FISHING

The data illustrates the clustering of activity in the key fishing grounds, e.g. to the north-west of Orkney, and the entrance and exits at the key fishing harbours and ports, e.g. Scrabster.

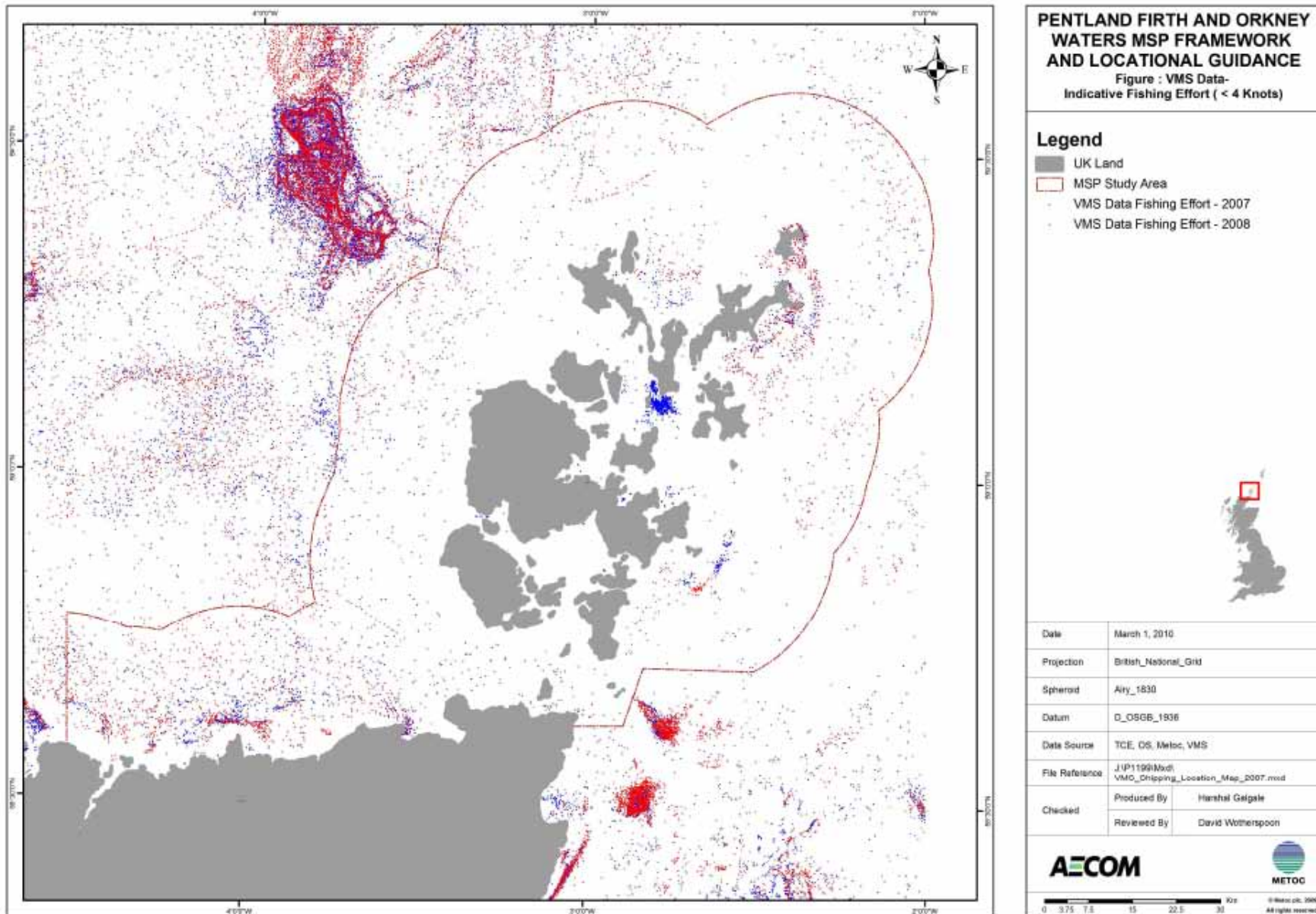
Within the 12 nautical mile limit, most activity for vessels in this size range appears to be vessels transiting through the area. There is fishing effort at the coast of Sanday and North Ronaldsay. The clustering around the Falls of Warness area is due to fishing vessels being on hire for developments at the EMEC tidal site in 2008, rather than actual fishing effort.

To distinguish where fishing effort is actually taking place, rather than merely vessels in transit in or through an area, an indicative fishing map has been produced which only shows data for vessels moving at less than 4 knots.

This indicative fishing effort map, shown below, identifies the key areas of activity for vessels greater than 15m in length as being predominantly outwith the 12 nautical mile limit and therefore outwith the current areas of interest for development of wave and tidal energy sites for this MSP and RLG.

SECTION 4: INTERACTION WITH OTHER SECTORS - FISHING

Figure 4.3: Indicative Fishing Effort Map



SECTION 4: INTERACTION WITH OTHER SECTORS - FISHING

The Scottish Sea Fisheries Statistics 2008 indicates that there were 150 Scottish based active fishing vessels in the Orkney area and a further 129 in the Scrabster/Wick area (all vessels sizes, not just those over 15m).

Just over 20% of the overall Scottish based vessels are greater than 15m in length. Therefore a significant number of smaller vessels likely to be operating in the area are not shown in the above chart, e.g. those involved in the crab, lobster and scallop fishing in the nearshore areas. For the Orkney port district less than 10% of the fishing vessels are greater than 15m and only 5% of the vessels in the Scrabster/Wick area are greater than 15m.

The value of landings in 2008 in the Orkney area by Scottish based vessels was approximately £5.6M (predominantly shellfish) and that in the Scrabster/Wick area was £18.7M (demersal species and shellfish).

At a national level, nearly 40% of the value of shellfish landings is from vessels of less than 15m length. By contrast, only 1% of the value of demersal species landings is from these smaller vessels.

This again indicates that the main interaction with fishing activity with renewable energy developments within the 12nm limit is likely to be with the smaller vessels undertaking creel fishing, dredging or dive collection for shellfish species. A wider level of interaction also occurs for the navigation interests of fishing vessels.

SECTION 4: INTERACTION WITH OTHER SECTORS - SHIPPING

Shipping

The Pentland Firth and Orkney Waters are utilised by a variety of vessels for various cargoes, passenger ferried, recreation and fishing. Information used in the SEA for wave and tidal energy development has been utilised to assess the level of activity and types of vessels encountered. Further consideration will also need to be given to the potential development of a container transshipment hub at Scapa Flow and the changes in vessel types, frequencies and operating routes that this may bring.

Data Sources

The main vessel traffic data used in the SEA was provided by the Maritime and Coastguard Agency (MCA) Automatic Identification System (AIS) Network. Vessels of 300 gross registered tonnes and above are required to carry AIS equipment, which transmits information about the ship and its movements to other suitably equipped vessels and coastal authorities. These records should therefore include well over 90% of commercial vessels; allowing for some transmission losses and other technical problems. However, naval vessels and vessels under 300GT are not required to carry the AIS equipment. Therefore small commercial ships, most naval vessels, most yachts, recreational craft and fishing vessels will not be included in the data set. This data set was acquired for two 2-week periods in 2006 (18th to the 31st January and 1st to the 14th August). Although this data only 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 numbers of vessels transiting the area per day. It also gives an indication of the level of seasonal variation in shipping activities.

The VMS data for fishing vessels greater than 15m in length has also been referred to, to extend the coverage of known vessel movements.

Admiralty Charts

Areas to be avoided are in force around Orkney. These areas are designated to avoid the risk of pollution and apply to vessels over 5000 gross registered tonnes carrying oil or other hazardous cargoes. In addition, the admiralty charts also note that the very strong tidal streams in the Pentland Firth can represent a hazard to shipping, and that laden tankers from the Orkney area should not use the Pentland Firth in restricted visibility or adverse weather.

Recognised Sea Lanes Essential to International Navigation

When considering the level and importance of shipping activity across the study area it is relevant to take into account “recognised sea lanes essential to international navigation”. The Energy Act 2004 makes reference to this term in relation to requirements to maintain the safety and sustainability of shipping, which is a requirement under the United Nations Law of the Sea (UNCLOS). Under this legislation Scottish Ministers may not grant consent in relation to offshore energy generating activities if they consider that interference with the use of recognised sea lanes essential to international navigation is likely to be caused.

The use of recognised sea lanes essential to international navigation” means:

- (a) anything that constitutes the use of such a sea lane for the purposes of Article 60(7) of the United Nations Convention on the Law of the Sea 1982 (Cmnd 8941); or
- (b) any use of waters in the territorial sea adjacent to Great Britain that would fall within paragraph (a) if the waters were in a Renewable Energy Zone.

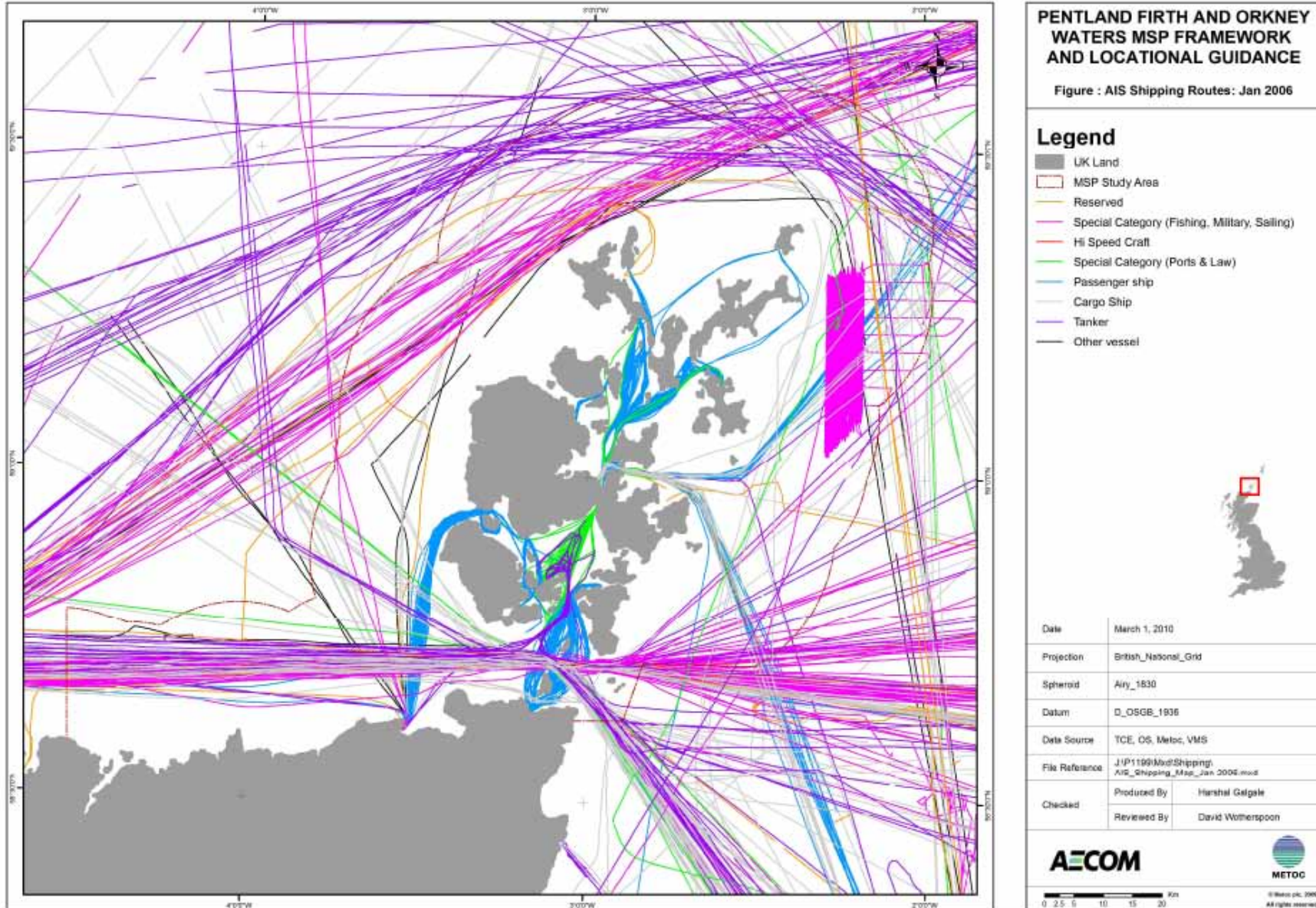
In considering what interference is likely to be caused by those generating activities subsection (3) of section 36B requires the Secretary of State and Scottish Ministers to take into account the cumulative impact of both generating activities which have already received consents and those which are likely to be granted consent.

The United Kingdom has also specifically recognised a right of innocent passage through the Pentland Firth as well as the right of transit passage in a number of other areas. The NOREL subgroup in a BERR report (2005) stated that “Having recognised these rights, it would be inconsistent not to recognise these straits and other passages as sea lanes as essential for international navigation, or at least those parts of the straits and other passages used by ships.”

The entrances to ports and harbours are also extremely important for shipping and navigation. There are port facilities in the study area which are essential for ferry traffic and local trade and supplies.

SECTION 4: INTERACTION WITH OTHER SECTORS - SHIPPING

Figure 4.4: AIS Shipping Routes, January 2006



SECTION 4: INTERACTION WITH OTHER SECTORS - SHIPPING

The AIS data clearly shows the laden tankers and vessels with dangerous cargoes using the routing around the north of the Orkney Islands, obeying the “Areas to be avoided” recommended route. There is also a heavy presence of transiting large fishing vessels during this winter period. Survey operations are also evident to the east of the northern Orkney Islands.

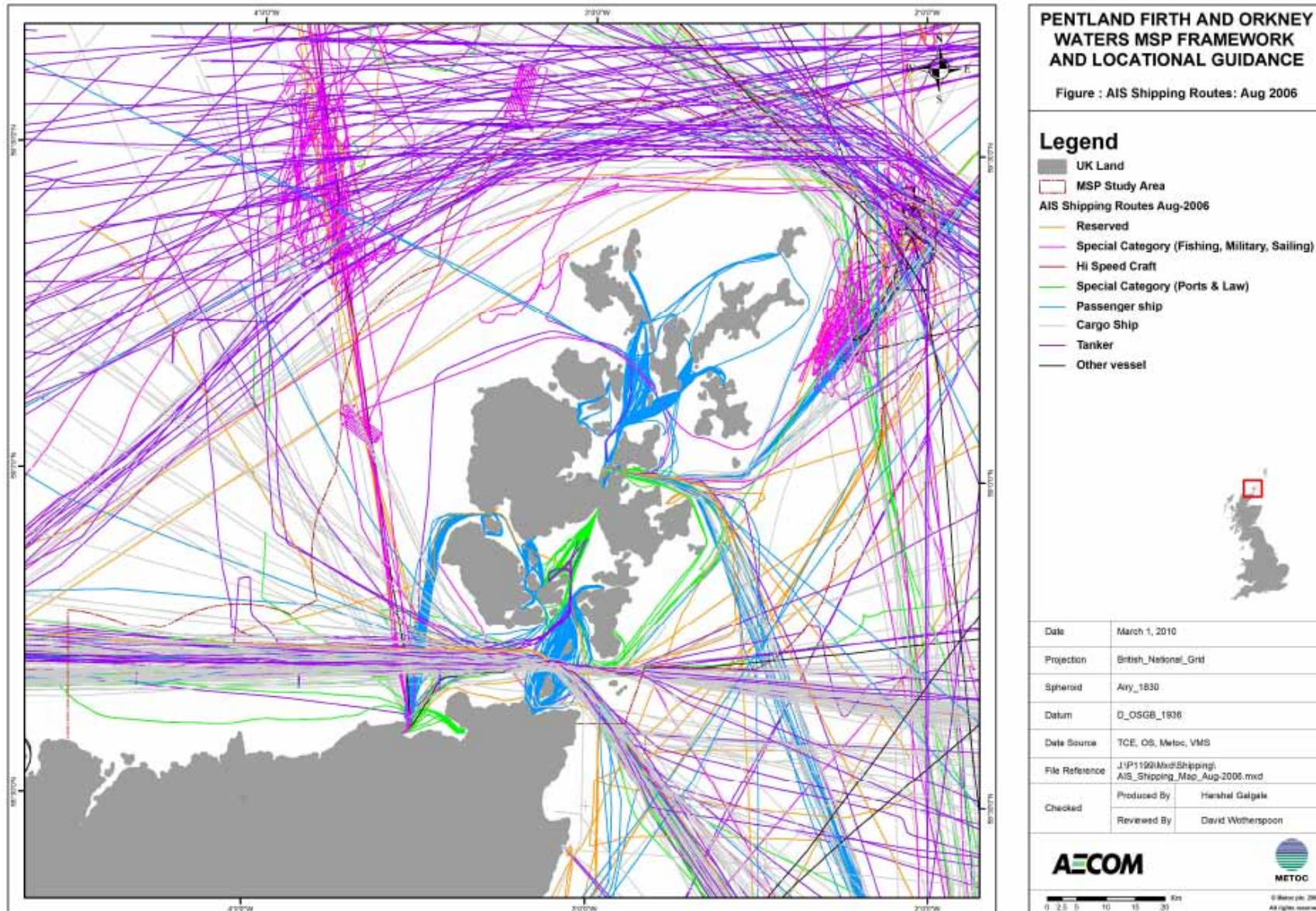
Within the Orkney Islands areas, the main activity shown from the AIS data is predominantly the ferry operations and port vessels (tugs), with cargo vessels, ferries and a small number of tankers entering and leaving Kirkwall. Tankers also enter and exit Scapa Flow, predominantly using the western recommended track for the facilities at Flotta.

The Pentland Firth itself is transited by all vessel types – tankers, cargo vessels, fishing vessels. There is a predominant east-west passage of vessels, but the ferry operations cross this traffic in a north-south direction. The plot represents a full two weeks of data and serves to illustrate the general routing taken.

The AIS data can be supplemented by also referring to the charts for fishing vessels referred to in the previous section. This however, still omits vessels of less than 15m in size from the full consideration of activity in this area.

SECTION 4: INTERACTION WITH OTHER SECTORS - SHIPPING

Figure 4.5: AIS Shipping Routes, August 2006



SECTION 4: INTERACTION WITH OTHER SECTORS - SHIPPING

The summer snapshot of vessel movements shows similar general trends, but an increase in tanker traffic around the north of the Orkney islands, an increase in cargo vessels and a reduction in transiting fishing vessels.

It is clear even from this limited dataset that there is the potential for significant interaction between marine renewable energy developments and shipping and navigation interests in this area, both on an individual device type basis and a larger cumulative basis should a number of farms be developed throughout this area.

SECTION 5: WAVE DEVELOPMENT AREAS

This section provides a summary of the development opportunities in each of the identified wave development areas described above. In summary these are:

Wave Area 1 – Whiten Head to Thurso

Wave Area 2 – Hoy/Mainland/Rousay

Wave Area 3 – Westray to North Ronaldsay

For each area the following information is provided:

A Figure identifying the Area

A Figure showing other sea users, overlapping interests and potential constraints

A summary of the key issues that will need to be addressed to evaluate the areas development potential.

WAVE AREA 1 – WHITEN HEAD TO THURSO

SUMMARY

This is an opportunity area for wave energy development. Offshore, immediately north of the main shipping route, wave energy levels of 25 kW/m exist which should be sufficient for commercial arrays. The near shore zone has significantly lower energy levels but may be suitable for those devices specifically designed to operate in shallower waters.

The area around the entrance to the Pentland Firth is heavily used by shipping, east-west and north-south, has a number of environmentally protected areas in the immediate vicinity and has a lower energy resource availability. This area would not be recommended for marine energy developments.

RESOURCE

Suitable wave energy potential exists off the Caithness mainland. Within the 12 nautical mile limit the energy potential is lower than that immediately outwith this boundary. The energy levels close to shore are generally lower than that present on the west coast of the Orkney Islands.

A wave resource of greater than 25kW/m, potential suitable for commercial development, occurs some 15 km from the mainland, approximately co-incident with the northern part of the existing main east-west shipping route through the Pentland Firth.

BATHYMETRY AND SEABED

A depth of 50m is reached within 2 to 4 km of the coastline, sufficient for moored devices, and depths vary up to 100m. Shoreline devices could be located along the coastline in the shallower waters, with some devices able to be deployed in depths of 10-15 m.

Seabed surface geology varies between sands and gravels, although information in the inshore area between the Kyle of Tongue area and Strathy Point is not available.

SHIPPING

There is an obvious route east-west through Pentland Firth traversed by vessels. These are predominantly tankers, cargo vessels and fishing vessels. There is an opportunity to locate development sites to north of main shipping routes. The eastern end of this zone is more densely trafficked, with vessels operating north-south (including the Scrabster-Stromness ferry) as well as east-west.

There appears to be sufficient opportunity to deploy nearshore and offshore wave energy devices in this area whilst avoiding the main shipping areas and any significant conflicts between uses. The eastern end of this zone at the mouth of the Pentland Firth would not however be recommended for marine energy deployments.

FISHING

The inshore area of this zone supports lobster, brown and velvet crab and pot fishing. The offshore area supports demersal and pelagic trawling. Fishing vessels transit through and operate within the area. Indicative fishing data (vessels operating at <4knots) suggest that the main fishing effort is undertaken in the key fishing grounds outwith the 12 nautical mile limit. However, there are areas such as Strathy Point and offshore of the Kyle of Tongue that have VMS data indicating activity in these areas.

There is likely to be an effect on fishing activity via the introduction of marine energy developments in this area through displacement and/or exclusion from areas.

MARICULTURE

A shellfish harvesting area is located in the Kyle of Tongue along with two shellfish farms. No significant interactions are likely.

ENVIRONMENTAL FEATURES

The shoreline has a variety of designations including Ramsar, SAC, SSSI, SPA and proposed marine extensions to SPAs.

WAVE AREA 1 – WHITEN HEAD TO THURSO

The Caithness and Sutherland Peatlands is a **Ramsar** site and an **SAC** and forms the largest and most intact blanket bog in Scotland and also supports a number of rare species of wetland plants and animals. This will be of importance for the routing of any lands based power lines required to support marine energy developments in this areas.

The same peatlands area is also designated as an **SPA** for nationally and internationally important breeding bird populations. The qualifying species are black-throated diver, common scoter, dunlin, golden eagle and golden plover, although a number of other non-qualifying but nationally important species are also present.

The presence of these bird species along this coast will potentially influence the timing and locations of shore based infrastructure activities and nearshore operations and developments.

A number of **SSSIs** exist along the Caithness coastline: Aird Torrisdale, Ben Huttig, Eilean nan Ron, North Sutherland Coastal Islands, Strathy Coast, Holborn Head, Lochan buide Mires, Red Point Coast, Snadside bay, Ushat Head and Invernaver. These contain a variety of notified and potentially qualifying flora and fauna species and geological and geomorphological features. The details of these features can be obtained via the SNH website and each will have to be considered in relation both land and marine elements of development projects.

The North Caithness Cliffs **SPA** is of British and European importance for populations of breeding seabirds. The specific areas making up the site extend beyond the boundaries of this area, but all areas will have to be considered for potential effects. The SPA overlaps wholly or partly with the SSSIs at Duncansby Head, Stroma, Dunnet Head and Red Point Coast. The seaward extension extends 2 km in to the marine environment to include the seabed, water column and surface. The qualifying features include the breeding seabird assemblage and the specific breeding species of fulmar, guillemot, kittiwake, peregrine, puffin and razorbill.

Further SPAs exist at the North Sutherland Coastal Islands (non-breeding Greenland Barnacle Goose), immediately adjacent to the eastern end of this zone on Hoy (breeding bird assemblage and specific species) and immediately adjacent to the western end of this area at Cape Wrath (specific breeding species).

The presence of these SPAs will require detailed consideration of the potential interaction with the bird population and behaviours within and adjacent to the

SPA. Initial development within an SPA is likely to require a level of proof of lack of effect through initial deployment and monitoring at other locations and larger scale developments following on from an initial small scale stage are likely to require further monitoring to demonstrate lack of effect.

SACs are also present at Invernaver (heathland, fen, grassland and sand dunes), Strathy Point (vegetated sea cliffs), River Thurso (Atlantic salmon), River Naver (Atlantic salmon and freshwater pearl mussel) and River Borgie (Atlantic salmon, freshwater pearl mussel and otter).

These SACs may require potential interactions with migratory salmon to be considered for large scale arrays in the nearshore area or potential cumulative issues between different developments.

Marine species such as Minke whale, white-beaked dolphin and harbour porpoise have been observed within the area. There is a general lack of data on cetaceans and consideration will have to be given to potential impacts from developments and potential survey and monitoring requirements.

The area around Kyle of Tongue is also a **National Scenic Area**.

RECREATION AND TOURISM

The RYA has light and medium recreational sailing routes through the area. The Pentland Firth RYA Yacht Club is located in Scrabster. Land based tourism centred around walking, archaeological sites of interest, wildlife & nature. The Thurso area is used by surfers and sea angling and sea kayaking are popular.

The potential impact on recreational sailing and other water based activities will be through potential displacement or exclusion from specific areas, predominantly in the nearshore environment. It is likely that alternative routes or areas will be available to these activities within the broad area of opportunity for wave energy developments in this area.

CULTURAL HERITAGE

Offshore wrecks exist. No major issues envisaged with potential interactions that cannot be avoided or mitigated.

WAVE AREA 1 – WHITEN HEAD TO THURSO

Land based development aspects will be controlled under existing planning permission measures for siting and potential impacts.

With appropriate consideration and mitigation, marine renewables are likely to be able to co-exist or be appropriately sited with cultural heritage uses.

EXISTING INFRASTRUCTURE

The Dounreay nuclear facility lies towards the east of this zone. Possible contamination issues in sandy areas (e.g. potential cable landing points). Hub for grid reinforcement issues.

Existing cable infrastructure connects through Dunnet Bay and should be avoided in any development area plans, although crossing with new cable infrastructure can be accommodated.

PORTS AND HARBOURS

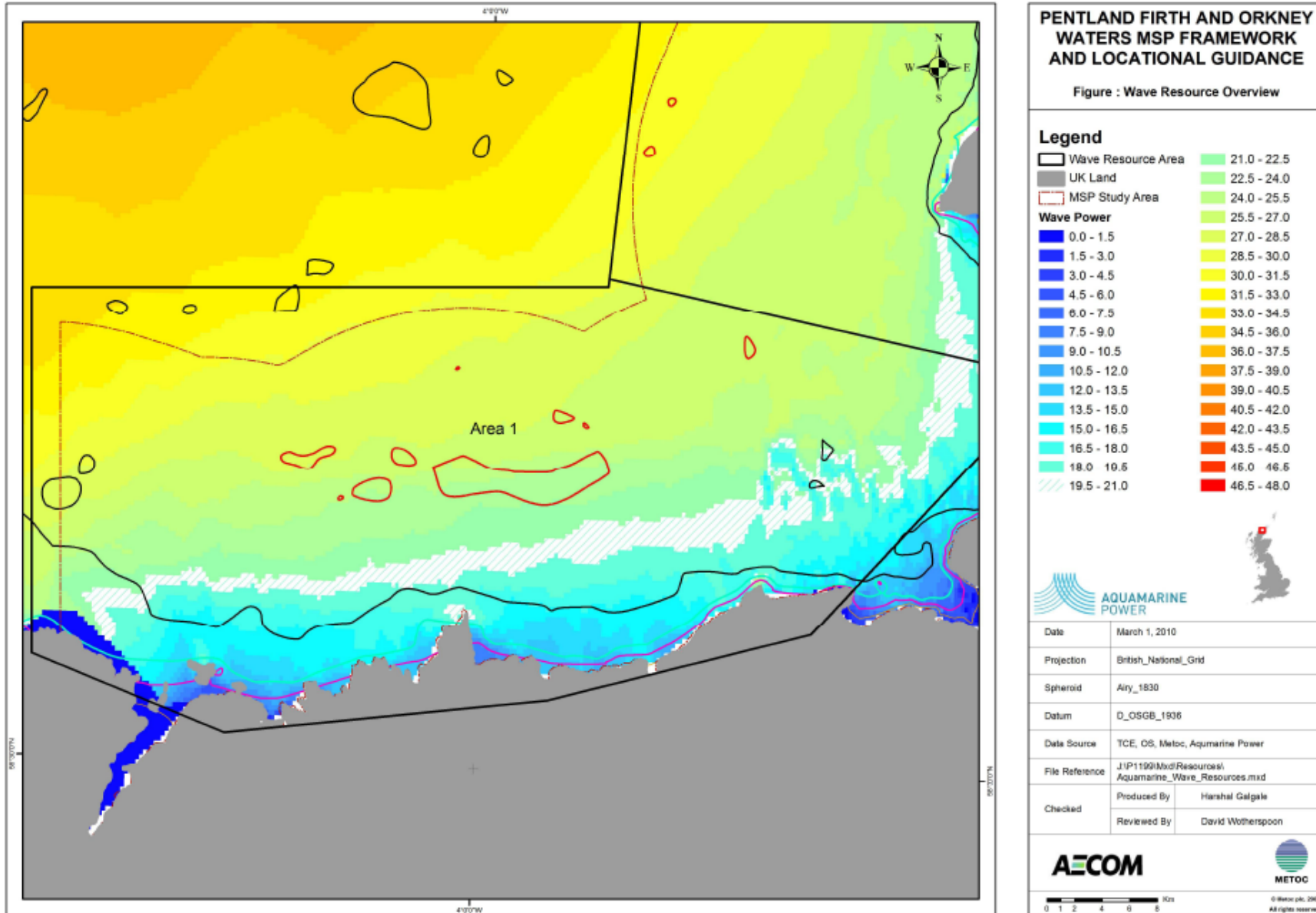
Scrabster Harbour is located towards the east of this area serving fishing, ferry and recreational vessels. The Harbour Trust has significant plans to develop the harbour facilities to accommodate marine renewable developments.

OTHER USERS

The area is an MOD practice and exercise area, but no specific concerns on interaction with marine renewables have been raised.

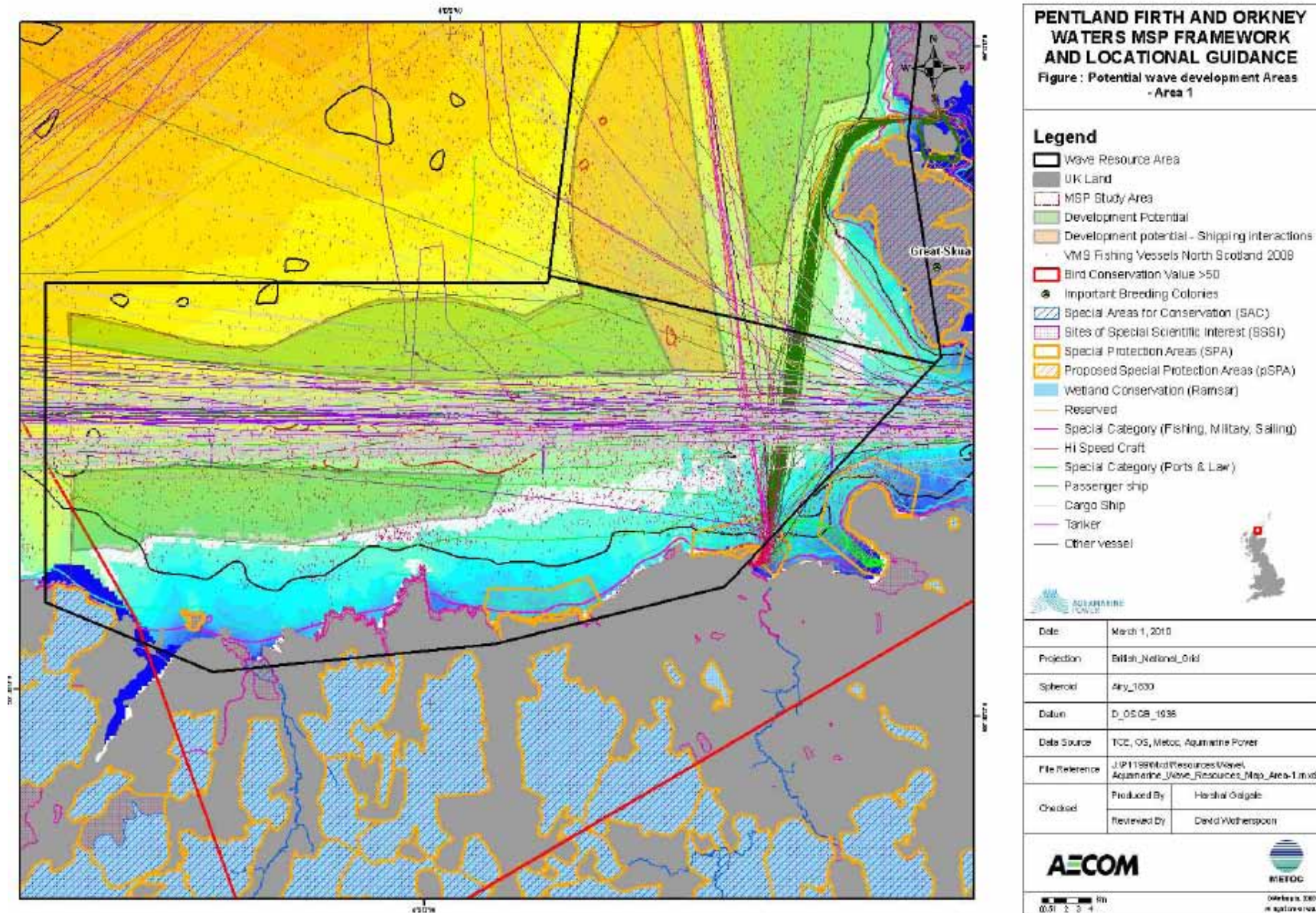
WAVE AREA 1 – WHITEN HEAD TO THURSO

Figure 5.1a: Wave Resource Overview



WAVE AREA 1 – WHITEN HEAD TO THURSO

Figure 5.1b: Wave Area 1 – Potential Development Areas



WAVE AREA 2 – HOY/MAINLAND/ROUSAY

SUMMARY

This is a significant opportunity area for wave energy development, both nearshore and offshore. Exploitable wave energy levels of 20-25 kW/m are available immediately adjacent to the coast .

The broad area within the 12 nautical mile limit as defined by the current plan is suitable for wave energy development. The Stromness-Scrabster ferry route in the south-east of this zone should be avoided and is not recommended for development. The area has been split into two effective zones of opportunity to allow a clear transit route for fishing vessels, but the exact boundary lines for this can be further refined.

The current plan boundary is for the 12 nautical mile limit, but developers may come forward with potential areas outwith the limit. Any such proposal should not be constrained by this plan.

RESOURCE

Suitable wave energy potential exists immediately off the Orkney Mainland and Rousay. Larger wave energy potential is also present outwith the 12 nautical mile limit, and although the present areas of opportunity are currently defined to this boundary, the plan should not constrain any applications made for areas outwith this limit.

BATHYMETRY AND SEABED

The seabed adjacent to this sea cliff coastline drops rapidly to 30m and shelves quickly to 50m, typically within 2 to 3km of the coastline. Thereafter, the seabed shelves more gently to 100m, with depths greater than 100m present at the western edge of the zone.

The rapid shelving to 50m means that it may be possible for moored offshore devices and shoreline devices to be proposed within short distances of each other, and potential cumulative effects will have to be considered.

Seabed surface geology varies between sands and gravels, although information in the inshore area is sparse.

SHIPPING

Potential tanker traffic is kept further offshore by the IMO recognised routing measures in place around the west coast of Orkney, meaning that this area is not as heavily utilised by shipping as would otherwise have been the case. The Stromness-Scrabster ferry operates in the south-east of this zone and this area has not been regarded as a potential deployment area to avoid potential conflicts with this critical ferry route.

The area has been split into two effective zones of opportunity to allow a clear transit route for fishing vessels, but the exact boundary lines for this can be further refined.

There is a significant opportunity to deploy both nearshore and offshore wave energy devices in this area whilst avoiding the main shipping areas and any significant conflicts between uses.

FISHING

The inshore area of this zone supports lobster, brown and velvet crab and pot fishing and possibly limited areas for scallop. The offshore area supports demersal and pelagic trawling. Fishing vessels transit through and operate within the area. Indicative fishing data (vessels operating at <4knots) suggest that the main fishing effort is undertaken in the key fishing grounds outwith the 12 nautical mile limit.

There is likely to be an effect on fishing activity via the introduction of marine energy developments in this area through displacement and/or exclusion from areas, but the opportunity area is sufficiently large that this issues is expected to be readily accommodated within the overall area.

MARICULTURE

No mariculture sites are located within the coastal area of this zone.

Shellfish and finfish farms are located within Hoy Mouth and Scapa Flow, along with shellfish production areas and growing waters. No significant interactions are likely.

ENVIRONMENTAL FEATURES

The shoreline has a variety of designations including SAC, SSSI, SPA and proposed marine extensions to SPAs.

SPAs exist at Rousay, Hoy, Marwick Head and West Westray

At Rousay, as well as the general assemblage of breeding seabirds, specific species noted as qualifying features include Arctic skua, Arctic tern, Fulmar, Guillemot and Kittiwake

The Hoy SPA lists Arctic skua, fulmar, great black-backed gull, great skua, guillemot, kittiwake, peregrine, puffin and red-throated diver.

The sea-cliffs at Marwick head support guillemot and kittiwake breeding populations, the West Westray cliffs support large colonies of breeding auks and kittiwakes while the grassland and heathland areas support breeding colonies of skuas and terns.

The large seabird presence in the area will require consideration of potential impacts at a project level and at a strategic or cumulative assessment level. Individual projects may have effects such as displacement from specific areas, changes to behaviour patterns or specific interference with diving bird feeding. The potential cumulative effects of multiple projects may be more significant and area wide project development will need to be assessed through monitoring of initial developments.

The wetland features of the **SACs** at Hoy, Loch of Isbister and the Stromness Heaths and Coast will require consideration for any land based infrastructure requirements, as will the variety of qualifying features of the **SSSIs** at the Bay of Skail, Cruaday Quarry, Hoy, Loch of Isbister and the Loons, Marwick Head, Muckle Head and Selwick, Rousay the Stromness Heaths and Coast.

Marine species such as Minke whale, white-beaked dolphin and harbour porpoise have been observed within the area. There is a general lack of data on cetaceans and consideration will have to be given to potential impacts from developments and potential survey and monitoring requirements.

The area between Mainland and Hoy is a **National Scenic Area** and the adjacent headlands are areas of great landscape value.

RECREATION AND TOURISM

The RYA has light and medium recreational sailing routes through the area, with use being made of marinas at Stromness and Kirkwall, with access via Hoy Sound in the south and Eynhallow Sound in the north.

The potential impact on recreational sailing and other water based activities will be through potential displacement or exclusion from specific areas, predominantly in the nearshore environment. It is likely that alternative routes or areas will be available to these activities within the broad area of opportunity for wave energy developments in this area.

CULTURAL HERITAGE

A small number of live wrecks are located close to shore in this area. A number of SAMs and protected wrecks exist in Scapa Flow, but no interaction is envisaged with this area. No significant issues are envisaged with the development of wave energy sites, with regard to wreck sites.

The Mainland contains a World Heritage Site “The Heart of Neolithic Orkney” around Maeshowe, the Stones of Stenness, the Barnhouse Stone, the Watchstone, the Ring of Brodgar and associated funerary monuments and stone settings, and Skara Brae settlement. The buffer zones for visual influence on these sites must be considered for any wave development offshore of these features in the flat Orkney landscapes and seascapes.

The presence of these known archaeological features means that any land based excavation works in the vicinity will require rigorous archaeological appraisal.

Land based development aspects will be controlled under existing planning permission measures for sites and potential impacts.

EXISTING INFRASTRUCTURE

Cable links within the island groups are present, but there is no infrastructure in the offshore area of this zone.

Land based grid infrastructure is weak in this area and will require upgraded networks to

PORTS AND HARBOURS

The Orkney Islands have a number of ports and harbours capable of supporting development in this area. The closest port is Stromness and the sheltered area of Scapa Flow is immediately adjacent. These ports fall within the control of the Orkney Harbour Authority.

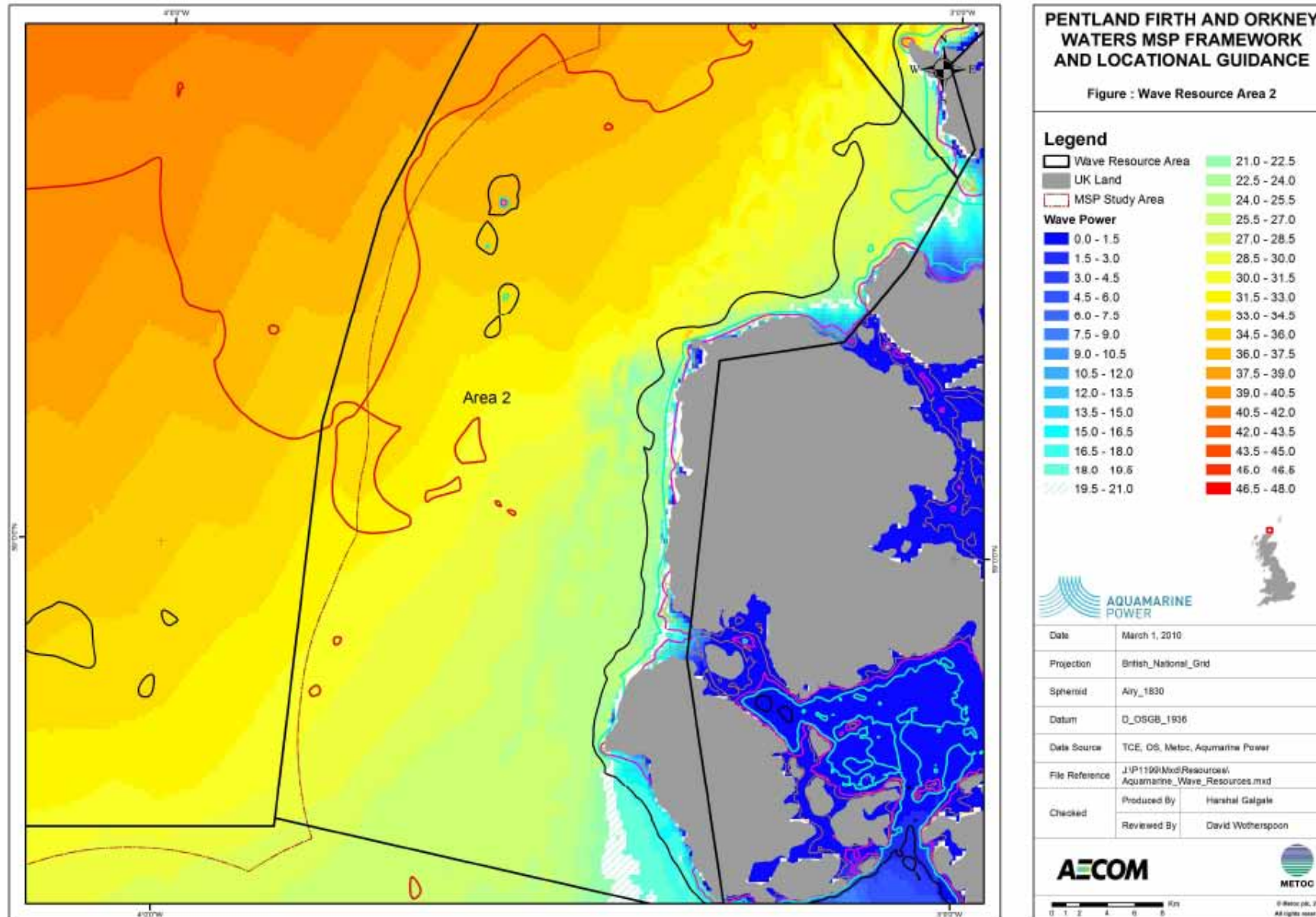
There are plans to potentially develop a container transshipment hub at Scapa Flow. Wave energy developments for this area are unlikely to have a major interaction with the potential hub development as the major approaches to Scapa Flow are to the south.

OTHER USERS

The southern part of this area is an MOD practice and exercise area, but no specific concerns on interaction with marine renewables have been raised.

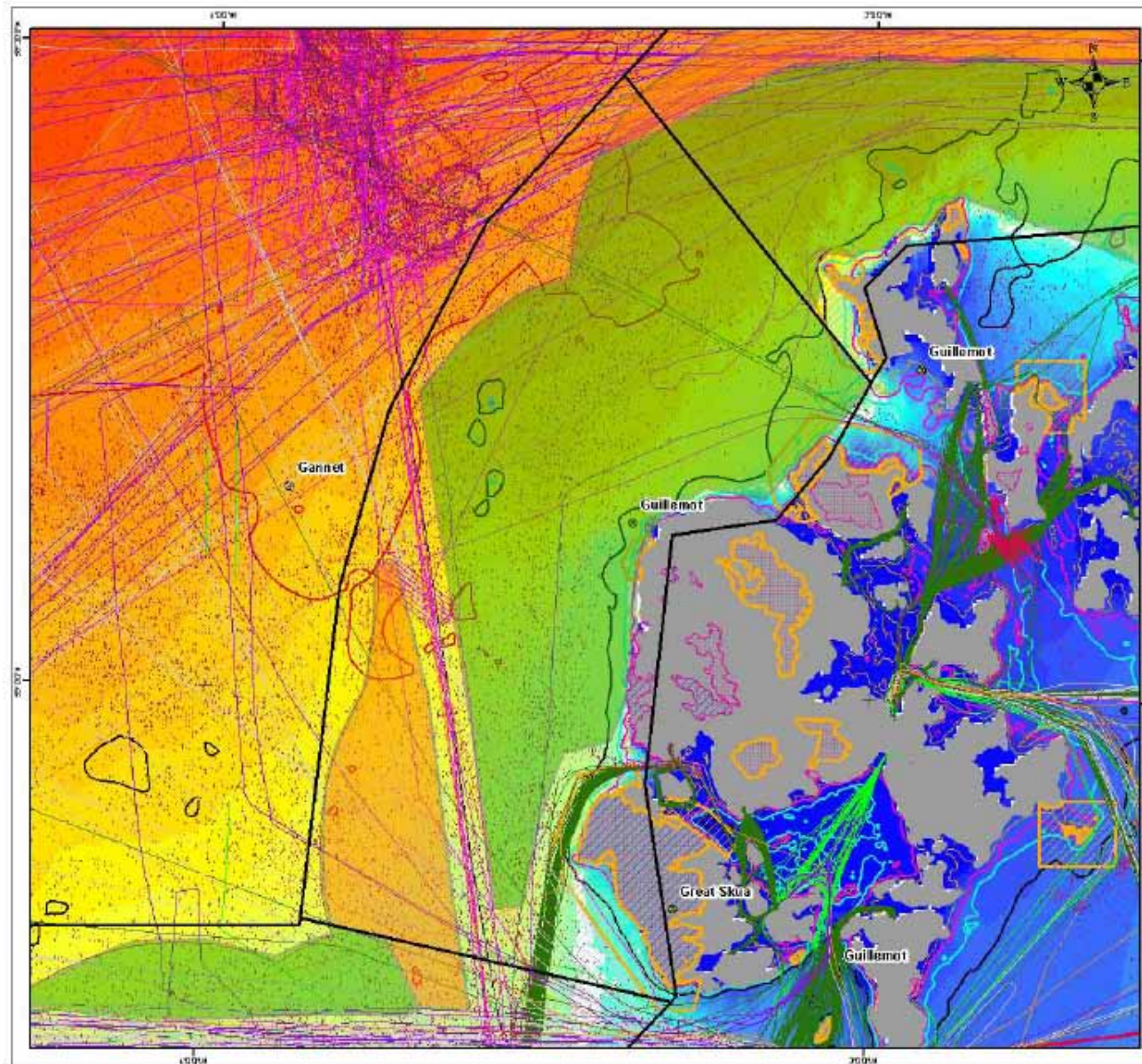
WAVE AREA 2 – HOY/MAINLAND/ROUSAY

Figure 5.2a: Wave Resource Area 2



WAVE AREA 2 – HOY/MANLAND/ROUSAY

Figure 5.2b: Wave Resource Detail Map Area 2



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE
 Figure : Wave Resource Detail Map Area - 2

Legend

- Wave Resource Area
- UK Land
- MSP Study Area
- Development Potential
- Development Potential - Shipping Interactions
- VMS Fishing Vessels North Scotland 2008
- VMS Fishing Vessels North Scotland 2007
- Bird Conservation Value >50
- Important Breeding Colonies
- Special Areas for Conservation (SAC)
- Sites of Special Scientific Interest (SSSI)
- Special Protection Areas (SPA)
- Proposed Special Protection Areas (pSPA)
- Wetland Conservation (Ramsar)
- Reserved
- Special Category (Fishing, Military, Sailing)
- Hi Speed Craft
- Special Category (Ports & Law)
- Passenger ship
- Cargo Ship
- Tanker
- Other vessel

AGUAMARINE POWER

Date	March 1, 2010
Projection	British_National_Grid
Spheroid	Airy_1830
Datum	D_OSGB_1936
Data Source	TCE, OS, Metoc, Aquamarine Power
File Reference	J:\P1158\WindResources\Wave\ Aquamarine_Wave_Resource_Map_Area-1.mxd
Checked	Produced By: Harshad Gajale
	Reviewed By: David Witherspoon

AECOM **METOC**

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October 2009
 or aquamarine.com

WAVE AREA 3 – WESTRAY TO NORTH RONLADSAY

SUMMARY

This is a significant opportunity area for wave energy development, both nearshore and offshore. Exploitable wave energy levels of 20-25 kW/m are available immediately adjacent to the coast.

The broad area within the 12 nautical mile limit as defined by the current plan is suitable for wave energy development. The offshore area to the north is more heavily trafficked by shipping and the development of this area for wave energy will require agreement on ship routing measures. Two potential areas of opportunity have therefore been defined – one in the area to the south of the main shipping routes and a second contiguous area out to the 12 nautical mile limit which could be adopted if agreement can be made on new shipping control measures

The current plan boundary is for the 12 nautical mile limit, but developers may come forward with potential areas outwith the limit. Any such proposal should not be constrained by this plan.

RESOURCE

Suitable wave energy potential exists immediately off at Westray, Papa Westray and North Ronaldsay. Larger wave energy potential is also present outwith the 12 nautical mile limit, and although the present areas of opportunity are currently defined to this boundary, the plan should not constrain any applications made for areas outwith this limit.

BATHYMETRY AND SEABED

The seabed drops rapidly to 30m and shelves to 50m typically within 3km to 6km of the coastline. The area within the territorial waters limit is generally less than 100m in depth.

Seabed surface geology varies between sands and gravels, although information in the inshore area is sparse.

SHIPPING

Potential tanker traffic is kept further offshore by the IMO recognised routing measures in place around the west coast of Orkney, but within the 12nm limit. The north and west parts of this area are trafficked by commercial shipping and fishing vessels.

Development of the offshore section of this zone would require agreement on navigation issues with the shipping industry and possibly the introduction of shipping control measures.

There is a significant opportunity to deploy both nearshore and offshore wave energy devices in this area whilst avoiding the main shipping areas and any significant conflicts between uses.

FISHING

The inshore area of this zone supports lobster, brown and velvet crab, pot fishing and dredge and dive scallop. The North Sound also supports whelk and pot fishing. The offshore area supports demersal and pelagic trawling.

Fishing vessels transit through and operate within the area. Indicative fishing data (vessels operating at <4knots) suggest that the main fishing effort is undertaken in the key fishing grounds outwith the 12 nautical mile limit, but activity also takes place close inshore on the west coast of North Ronaldsay and Sanday, as well as within the North Sound.

There is likely to be an effect on fishing activity via the introduction of marine energy developments in this area through displacement and/or exclusion from areas, but the opportunity area is sufficiently large that this issues is expected to be readily accommodated within the overall area.

MARICULTURE

No mariculture sites are located within the coastal area of this zone.

WAVE AREA 3 – WESTRAY TO NORTH RONLADSAY

ENVIRONMENTAL FEATURES

The shoreline has a variety of designations including SAC, SSSI, SPA and proposed marine extensions to SPAs.

SPAs exist at Papa Westray (North Hill and Holm) and West Westray, with qualifying species of Arctic skua, Arctic tern, fulmar, guillemot, kittiwake and razorbill. North Hill and West Westray are also **SSSIs**

The seabird presence in the area will require consideration of potential impacts at a project level and at a strategic or cumulative assessment level. Individual projects may have effects such as displacement from specific areas, changes to behaviour patterns or specific interference with diving bird feeding. The potential cumulative effects of multiple projects may be more significant and area wide project development will need to be assessed through monitoring of initial developments.

Marine species such as Minke whale, white-beaked dolphin and harbour porpoise have been observed within the area. There is a general lack of data on cetaceans and consideration will have to be given to potential impacts from developments and potential survey and monitoring requirements.

The area between Mainland and Hoy is a **National Scenic Area** and the adjacent headlands are areas of great landscape value.

RECREATION AND TOURISM

The RYA has light recreational sailing routes through the area, with use being made of a marina at Westray.

The potential impact on recreational sailing and other water based activities will be through potential displacement or exclusion from specific areas, predominantly in the nearshore environment. It is likely that alternative routes or areas will be available to these activities within the broad area of opportunity for wave energy developments in this area.

CULTURAL HERITAGE

A small number of live wrecks are located close to shore in this area, but no significant issues are envisaged.

EXISTING INFRASTRUCTURE

Cable links within the island groups are present, but there is no infrastructure in the offshore area of this zone.

Land based grid infrastructure is weak in this area and will require upgraded networks to accommodate marine energy developments.

PORTS AND HARBOURS

The Orkney Islands have a number of ports and harbours capable of supporting development in this area.

Plans to potentially develop a container transshipment hub at Scapa Flow may create an increase in traffic routed around the north of the Orkney Islands and this area.

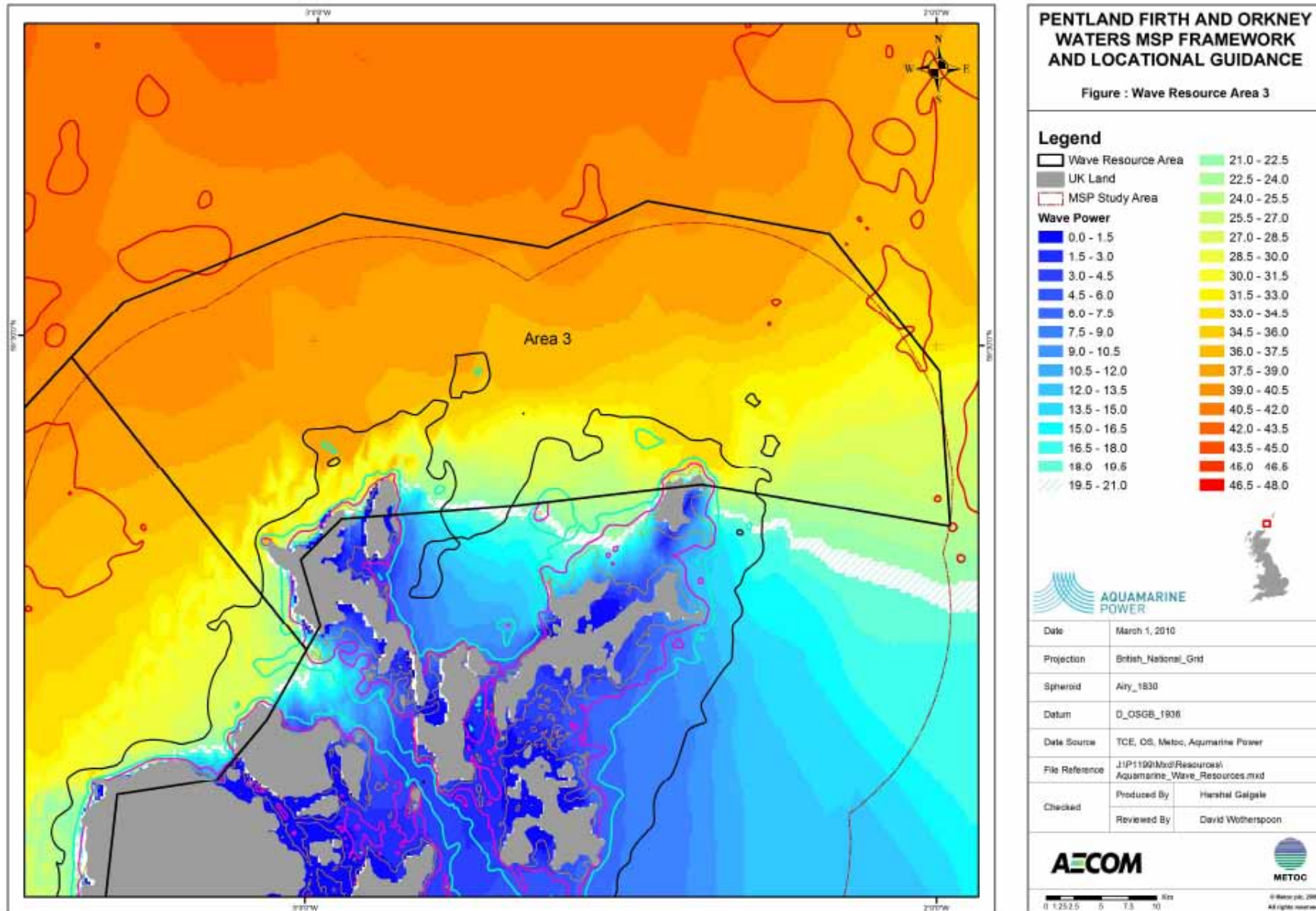
The projected increase in shipping movements and likely routes will require to be considered for the northern part of this area.

OTHER USERS

Military activities occur across a large portion of the Pentland Firth and this area lies entirely within an existing military practice area. The area is not however located in an area designated as a 'danger area' or a 'byelawed' area which have been designated by the MOD as typically marine renewable energy development 'no-go areas'.

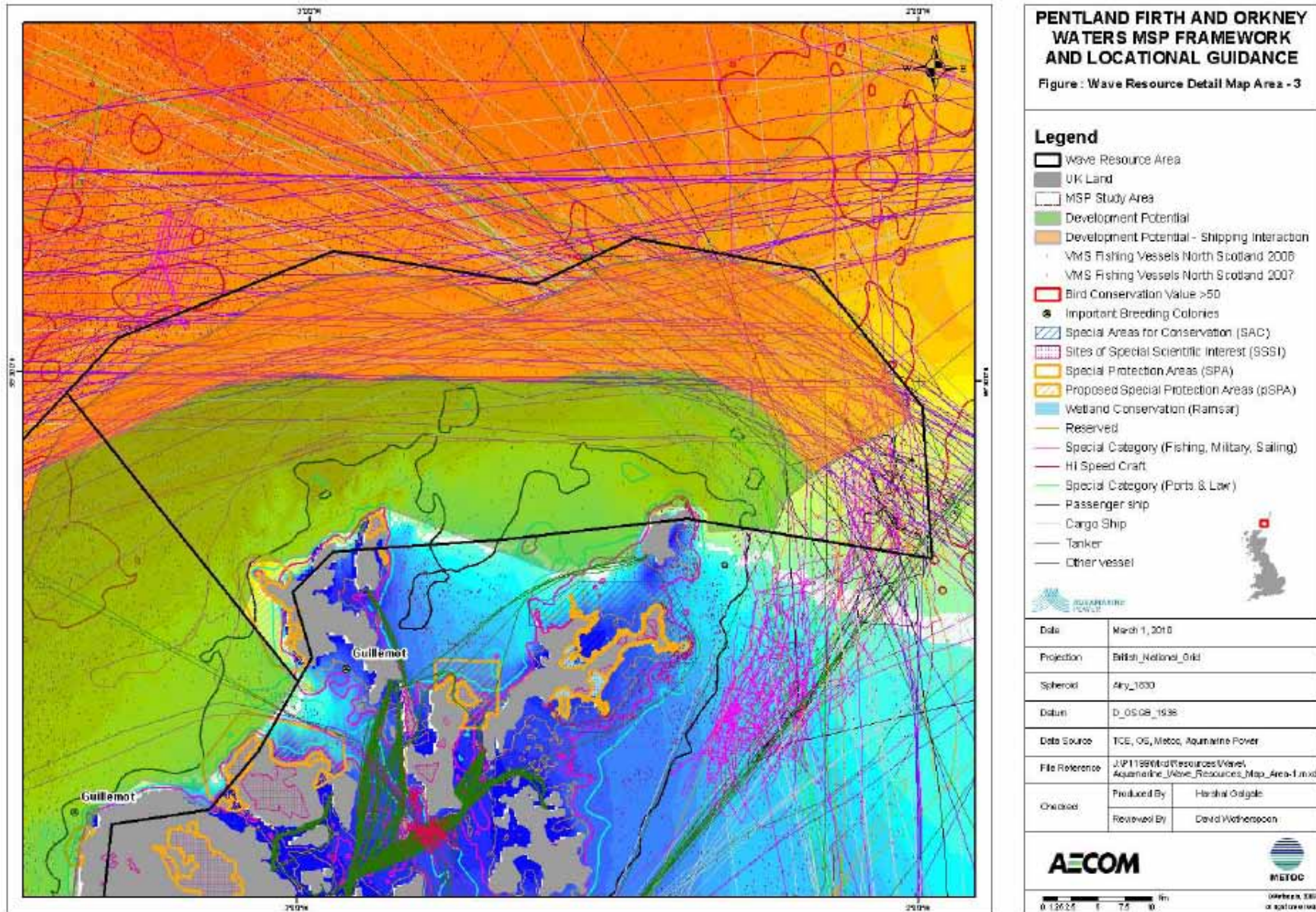
WAVE AREA 3 – WESTRAY TO NORTH RONLADSAY

Figure 5.3a: Wave Resource Area 3



WAVE AREA 3 – WESTRAY TO NORTH RONLADSAY

Figure 5.3b: Wave Resource Detail Map Area 3



SECTION 6: TIDAL DEVELOPMENT AREAS

This section provides a summary of the development opportunities in each of the identified tidal areas described above. In summary these are:

- Tidal Area 1 – Stroma Sound
- Tidal Area 2 – Duncansby Head
- Tidal Area 3 – Pentland Firth Outer Sound
- Tidal Area 4 – Swona and South Ronaldsay
- Tidal Area 5 – South Hoy/South Walls
- Tidal Area 6 – Graemsay (Hoy Sound/Burra Sound)
- Tidal Area 7 – Westray Firth to Stronsay Firth
- Tidal Area 8 – Papa Westray (Mull Head)
- Tidal Area 9 – Sanday and North Ronaldsay

For each area the following information is provided:

A Figure identifying the Area

A Figure showing other sea users, overlapping interests and potential constraints

A summary of the key issues that will need to be addressed to evaluate the areas development potential.

TIDAL AREA 1 – STROMA SOUND

SUMMARY

This area has a large resource opportunity for tidal development. Surface piercing devices will conflict with the ferry route which runs from Gills Bay to St Margaret's Hope on South Ronaldsay. Preference for tidal development in this area should therefore be given to submerged devices and the actual development area and device type selected to allow sufficient vessel clearance over devices at all tide states. The amount of clearance required must be formalised through a national level agreement between shipping interests and tidal energy interests, with 10m clearance being a possible starting point.

The area has been split into two opportunity types – one which could progress outwith the main ferry navigation route and a second type that would require agreement on clearance over the top of any devices. The potential development area is significant and contiguous if agreement can be reached on the navigation issues. These are likely to require national level agreements on the principles of potential co-use of areas and navigations safety issues.

RESOURCE

The Inner Sound, south of the Island of Stroma is relatively shallow, reaching a maximum depth of around 35m, but would potentially be suitable for tidal device deployment. The Inner Sound experiences peak spring flows of about 2.5ms^{-1} . There are significant tidal races southwest of the Island of Stroma and further east offshore the Ness of Duncansby on the mainland (the Duncansby Race). The Admiralty Pilot also notes a race forming off Ness of Huna during the east going stream. Eddies form on either side of Stroma during the relevant east or west going main streams

BATHYMETRY AND SEABED

The deepest section of Stroma Sound lies closer to the Island of Stroma than the Caithness mainland, reaching depths of 30 to 35m. The area to the south Stroma of Stroma shelves quickly to the 30m depth whilst a gentler gradient to these depths is presented from the mainland side.

Recent seabed surveys in the area by Marine Scotland, though not full in coverage, show the old red sandstone seabed to have ridges and troughs running approximately north-south with faults also present.

Sediment deposits are present to the east and west of Stroma, formed by the eddy currents from the island.

SHIPPING

The Gills Bay – St. Margaret's Hope ferry runs north-south through this area, traversing either side of Stroma as required. The AIS data shows that the ferry route can vary over a wide area, depending on the tidal state and weather conditions.

Data shows fishing vessels transiting through Stroma Sound on an east-west path.

FISHING

This area supports lobster, brown and velvet crab and pot fishing. Dredge and dive scallops activity takes place in the Gills Bay area.

Fishing vessels transit through the area. Indicative fishing data (vessels operating at $<4\text{knots}$) suggest that little or no commercial fishing effort from these larger vessels is undertaken in this area.

There is likely to be an effect on fishing activity via the introduction of marine energy developments in this area through displacement and/or exclusion from areas. The key interaction is likely to be with smaller fishing vessels utilised for the lobster and crab fishing.

MARICULTURE

No mariculture sites are located within this area.

ENVIRONMENTAL FEATURES

The shoreline has a variety of designations including SAC, SSSI, SPA and marine extensions to SPAs.

Birds present on the Scottish mainland north coast are protected by the North Caithness Cliffs SPA, and the Caithness and Sutherland Peatlands SPA and

TIDAL AREA 1 – STROMA SOUND

Ramsar site. The North Caithness Cliffs **SPA** is designated for breeding populations of razorbill, fulmar, kittiwake, peregrine, puffin and guillemot. A large proportion of the North Caithness Cliffs SPA comprises cliffs formed from Old Red Sandstone which provides ideal nesting sites for important populations of seabirds. The Caithness and Sutherland Peatlands SPA and Ramsar site is extensive, covering 143,500 hectares across northern Scotland. The diverse peatland and freshwater habitats which make up the SPA support a wide variety of breeding birds including internationally important populations of raptors, wildfowl and waders. This extensive area is also designated as an **SAC** to protect Annex I habitats (e.g. blanket bogs and natural dystrophic lakes and ponds), and the otter, an Annex II species.

This area, as with all others, is within the Orkney to Shetland Important Bird Area (**IBA**). Whilst IBAs are not afforded any statutory protection, they provide a useful indication as to which areas of the UK are important to seabirds. Within the study area, and in addition to the species mentioned above, shag, gannet, great skua, herring gull, great black-backed gull, cormorants, grebes, sea ducks and tern are also present at some point during the year. The herring gull is listed as a UKBAP priority species.

Stroma is also a **SSSI** which additionally lists shag and tern as important bird species on the island, along with its cliff top vegetation as a specific feature.

The John O'Groats **SSSI** is of interest for palaeontology due to the exposure of a layer of sedimentary rock which contains fossil fish.

Marine species such as Minke whale, white-beaked dolphin and harbour porpoise have been observed within the area. There is a general lack of data on cetaceans and consideration will have to be given to potential impacts from developments and potential survey and monitoring requirements.

Harbour and grey seals (EC Habitats Directive Annex II and UKBAP species) are also present in the study area, as are otters. Grey seals and harbour seals are the most frequently observed species, both of which can be found on Stroma. For grey seals in particular, the island is an important breeding site with approximately 650 pups born each year (Barne *et al.*, 1996).

Otters are known to be present around river mouths along the Caithness coastline, and are likely to be present on the island of Stroma. Otters are a European Protected Species, and a priority species in the Caithness LBAP.

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips (including to Stroma) to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. No RYA recreational sailing are noted for this area.

Land based tourism in the area is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include: walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest such as the Castle of Mey.

John O'Groats is the key tourist attraction in Caithness attracting visitors for its position at as the most north easterly point of Britain's mainland. It has a museum, the famous Last house and a craft village. John O'Groats Ferries operates wildlife cruises and is used by thousands of visitors a year for day trips to the Orkney Islands.

CULTURAL HERITAGE

A small number of live wrecks are located close to shore in this area, but no significant issues are envisaged.

Scheduled Ancient Monuments (SAMs) protected under the Ancient Monuments and Archaeological Areas Act 1979. Pastmap (2009) indicates that there are four SAMs on Stroma, including the fortified sea-stack of Castle Mestag situated near Mell Head. On the mainland there is the SAM of St John's Point (the fort and site of St John's Chapel).

Further sites of interest include numerous national monuments in addition to several listed buildings of architectural or historic interest which are protected under the Planning (Listed Buildings and Conservation Areas)(Scotland) Act 1997

TIDAL AREA 1 – STROMA SOUND

EXISTING INFRASTRUCTURE

No other seabed infrastructure is present in this area.

Land based grid infrastructure is weak in this area and will require upgraded networks to accommodate additional electricity generation from tidal energy developments.

PORTS AND HARBOURS

There are two small harbours on the coast of Caithness within this area. Gills Bay is the mainland port used by the ferry service to Orkney. A small harbour at John O'Groats operates boat tours and a summer ferry service. Although Stroma is uninhabited there is a small harbour on the south coast of the island which is used for island tour boats and the transport of cattle and sheep that are grazed on the island.

To the west of the area is the port of Scrabster which is frequented by fishing vessels, ferries and some cargo vessels. Although the ferries and cargo vessels using the port at Scrabster tend not to transit the site of the proposed array, fishing vessels *en route* to North Sea fishing grounds do pass through this area

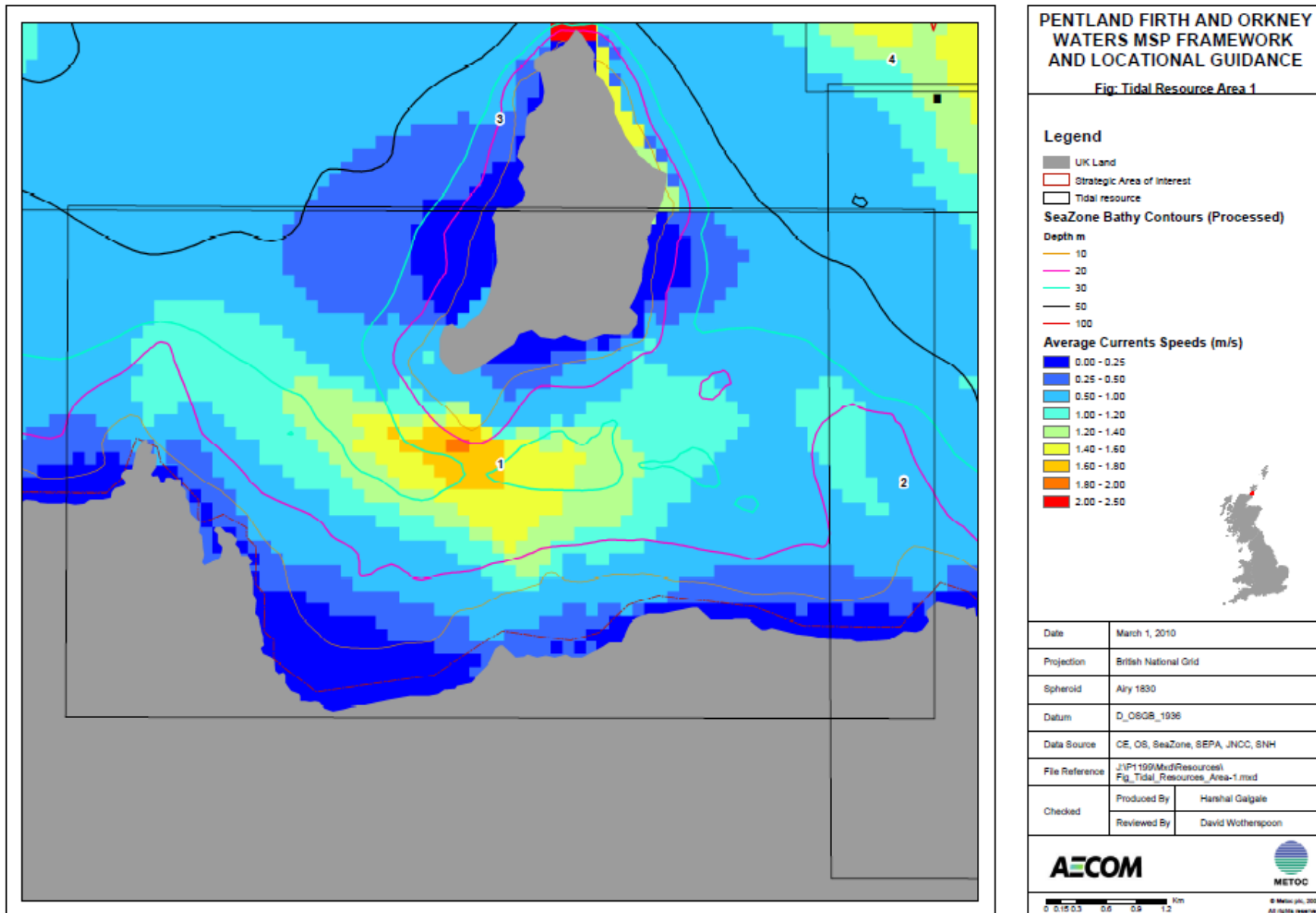
OTHER USERS

Stroma Sound has previously been used for dredging disposal. Recent surveys by Marine Scotland show no evidence of spoil deposits and it is highly likely that the high current velocities have dispersed the previously deposited material, and no new activity has been recorded since 2000.

Military activities occur across a large portion of the Pentland Firth and this area lies entirely within an existing military practice area. The area is not however located in an area designated as a "danger area" or a 'byelawed' area which have been designated by the MOD as typically marine renewable energy development 'no-go areas'.

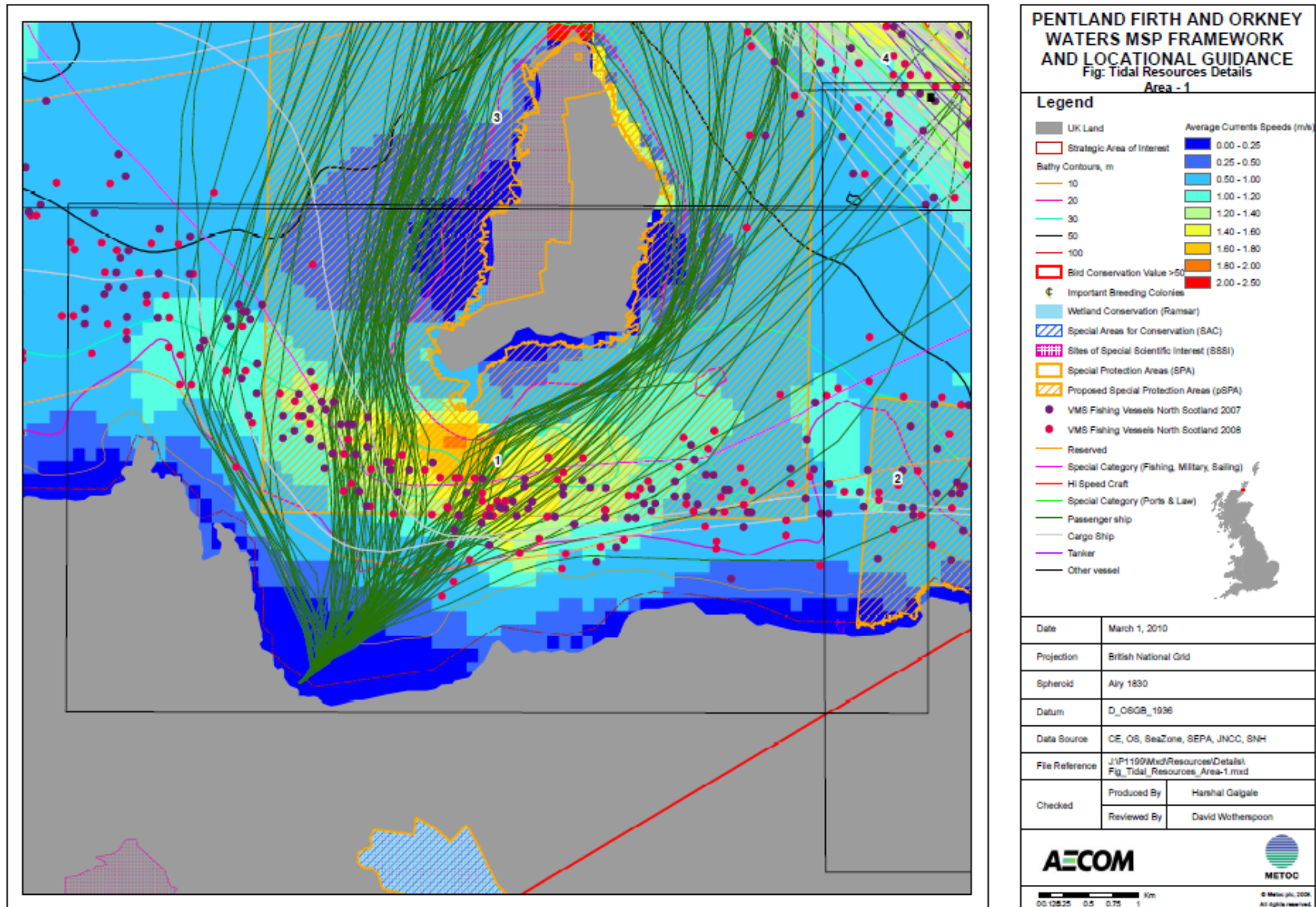
TIDAL AREA 1 – STROMA SOUND

Figure 6.1a: Tidal Resource Area 1



TIDAL AREA 1 – STROMA SOUND

Figure 6.1b: Tidal Resource Detail Map Area 1



TIDAL AREA 2 – DUNCANSBY HEAD

SUMMARY

This area has a large resource opportunity for tidal development. Surface piercing devices will conflict with the shipping which predominantly runs NE-SW off Duncansby Head. Fishing vessels, in addition to using the NE-SW track, also turn E-W to use the Stroma Sound route. However, the area is sufficiently large that it may be possible to accommodate both submerged and surface piercing tidal devices with appropriate measures introduced to route vessels away from development areas. It will also be necessary to reach agreement with shipping interests on safe navigational clearance over any submerged devices if co-use of areas is to be possible.

The area has been shown as two areas of potential east and west of the main shipping routes. The area currently used as the main NE-SW shipping route has significant potential if agreement can be reached on co-use with submerged devices.

RESOURCE

The potential resource in this area is considerable. Peak spring rates of 4ms^{-1} are also typical of the channel between the Pentland Skerries and Duncansby Head on the mainland, although close in to the Pentland Skerries flows as high as 6ms^{-1} are reported.

BATHYMETRY AND SEABED

Around Duncansby Head, the seabed quickly falls to 50m and then shelves to around 70m before rising again to the Pentland Skerries. Seabed surveys carried out by Marine Scotland science have shown significant areas of the rock seabed to be highly irregular, with abrupt changes steps in the bedrock levels, characterised by vertical walls and horizontal beds.

The Sandy Riddle is a bank of sand SSE of the Pentland Skerries. It is composed of sand dunes with a series of level platforms at a depth of around 20 metres. The dune waves are approximately 10 metres from crest to crest and of a depth of approximately 1 metre.

SHIPPING

The channel between Duncansby Head and the Pentland Skerries is heavily used by tankers, cargo vessels and other ships transiting through the Pentland Firth, from the North Sea to the Atlantic and vice versa.

The NE-SW routing off Duncansby Head takes vessels around the north side of Stroma before turning E-W for the Pentland Firth.

Fishing vessels transit through Stroma Sound on an east-west path.

FISHING

This area supports lobster, brown and velvet crabs and pot fishing.

Fishing vessels transit through the area. Indicative fishing data (vessels operating at $<4\text{knots}$) suggest that little or no commercial fishing effort from these larger vessels is undertaken in this area. The main fishing effort areas nearby appear to be to the east and south of the Sandy Riddle.

There is likely to be an effect on fishing activity via the introduction of marine energy developments in this area through displacement and/or exclusion from areas. The key interaction is likely to be with smaller fishing vessels utilised for the lobster and crab fishing.

MARICULTURE

No mariculture sites are located within this area.

ENVIRONMENTAL FEATURES

The cliffs at Duncansby Head are up to 65m high and are characterised by stacks, arches and steep-sided inlets or geos, providing ideal nesting sites for thousands of seabirds. Underwater the geos give way to huge sheltered caverns leading out to tide and wave battered walls on the seaward side. The geos support a rich and varied fauna.

The four uninhabited islands of the Pentland Skerries (Muckle Skerry, Little Skerry, Lougher Skerry and Clettack Skerry), to the northeast of Duncansby Head,

TIDAL AREA 2 – DUNCANSBY HEAD

are home to a grey seal colony and an abundance of terns. (www.seasearch.co.uk)

The Duncansby Head area forms part of the North Caithness Cliffs **SPA** as does the nearby Stroma area. Immediately adjacent are the Caithness and Sutherland Peatlands **SPA, SAC** and **Ramsar** site. Duncansby Head is also a **SSSI** and the Pentland Firth Islands (Swona and Muckle Skerry) is also a **SSSI** and **SPA**.

The North Caithness Cliffs **SPA** is designated for breeding populations of razorbill, fulmar, kittiwake, peregrine, puffin and guillemot. A large proportion of the North Caithness Cliffs SPA comprises cliffs formed from Old Red Sandstone which provides ideal nesting sites for important populations of seabirds. The Caithness and Sutherland Peatlands SPA and Ramsar site is extensive, covering 143,500 hectares across northern Scotland. The diverse peatland and freshwater habitats which make up the SPA support a wide variety of breeding birds including internationally important populations of raptors, wildfowl and waders. This extensive area is also designated as an **SAC** to protect Annex I habitats (e.g. blanket bogs and natural dystrophic lakes and ponds), and the otter, an Annex II species.

The Caithness Cliffs are also an Important Bird Area (**IBA**). Whilst IBAs are not afforded any statutory protection, they provide a useful indication as to which areas of the UK are important to seabirds.

The John O'Groats **SSSI** is of interest for palaeontology due to the exposure of a layer of sedimentary rock which contains fossil fish

The national biodiversity network lists **Marine species** such as grey seals, harbour seals, common porpoise and Atlantic white-sided dolphin in this area. There is a general lack of data on cetaceans and consideration will have to be given to potential impacts from developments and potential survey and monitoring requirements.

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips (including to Stroma) to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. RYA recreational sailing routes pass north-south to the Orkney Islands.

Land based tourism in the vicinity of the proposed development area is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include: walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest.

John O'Groats is the key tourist attraction in Caithness attracting visitors for its position at as the most north easterly point of Britain's mainland. It has a museum, the famous Last house and a craft village. John O'Groats Ferries operates wildlife cruises and is used by thousands of visitors a year for day trips to the Orkney Islands.

Tourism contributes significantly to the area's economy.

CULTURAL HERITAGE

A small number of live wrecks this area, but no significant issues are envisaged.

There are numerous national monuments including cairns, mounds and burial grounds which will need to be considered for any land-based infrastructure elements for tidal development in this area.

EXISTING INFRASTRUCTURE

No other seabed infrastructure is present in this area.

Land based grid infrastructure is weak in this area and will require upgraded networks to accommodate additional electricity generation from tidal energy developments.

PORTS AND HARBOURS

There are two small harbours on the coast of Caithness adjacent to this area. Gills Bay is the mainland port used by the ferry service to Orkney. A small harbour at John O'Groats operates boat tours and a summer ferry service. Although Stroma is uninhabited there is a small harbour on the south coast of the island which is used for island tour boats and the transport of cattle and sheep that are grazed on the island.

TIDAL AREA 2 – DUNCANSBY HEAD

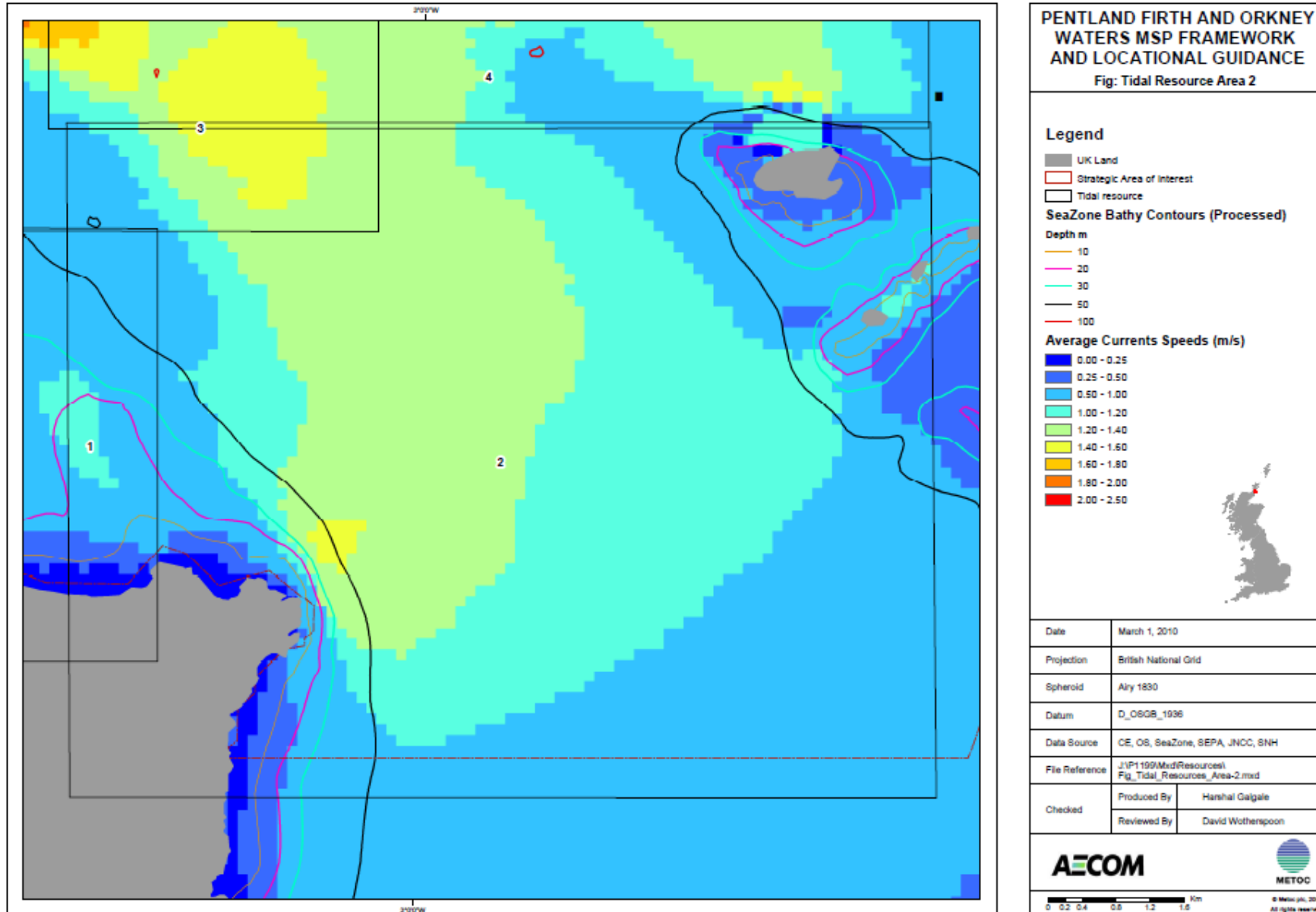
Further to the west of the area is the port of Scrabster which is frequented by fishing vessels, ferries and some cargo vessels. To the north lies the sheltered anchorage of Scapa Flow and facilities at Lyness and further to the south there is the harbour at Wick.

OTHER USERS

Military activities occur across a large portion of the Pentland Firth and this area lies entirely within an existing military practice area. The area is not however located in an area designated as a “danger area” or a ‘byelawed’ area which have been designated by the MOD as typically marine renewable energy development ‘no-go areas’.

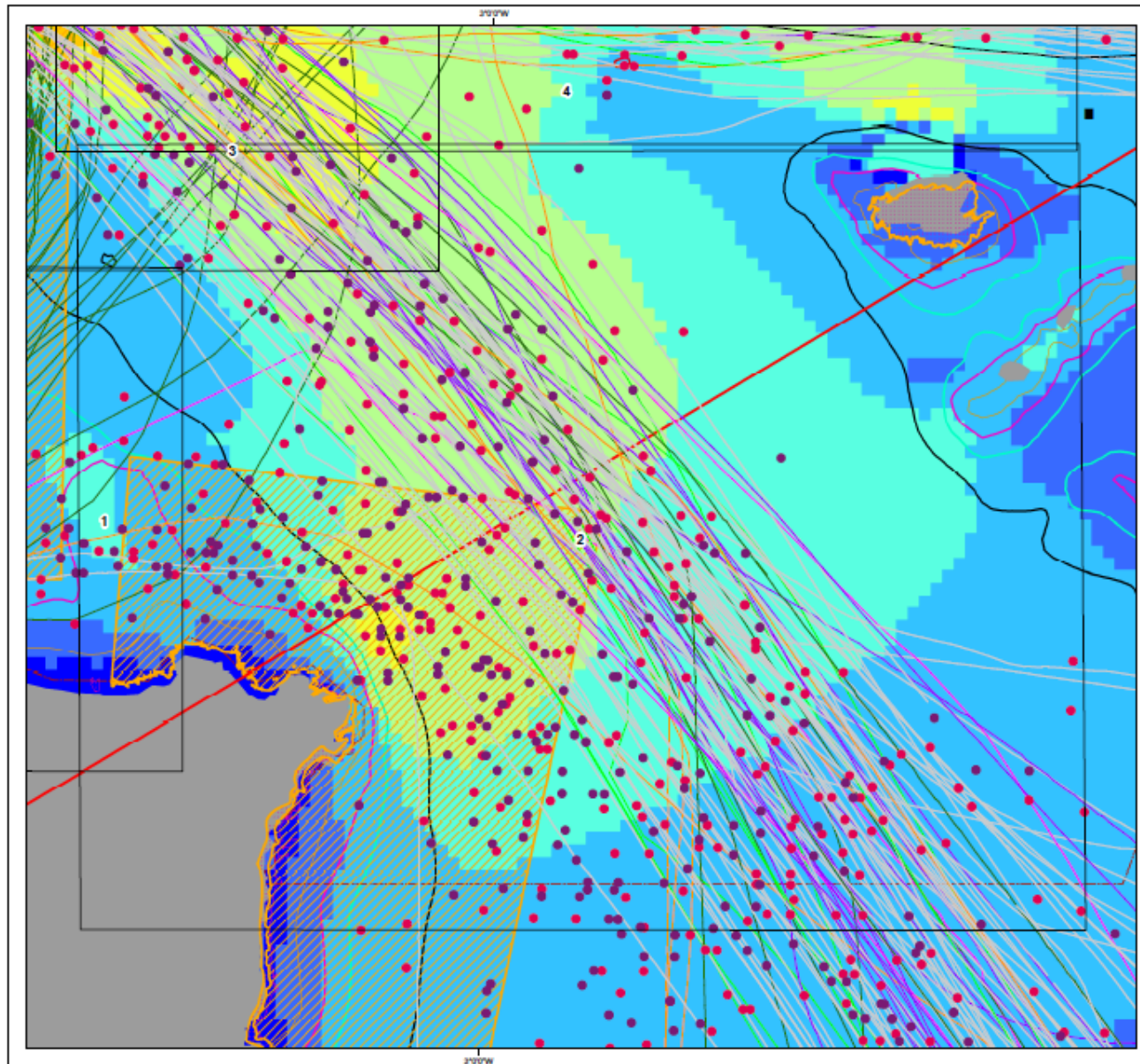
TIDAL AREA 2 – DUNCANSBY HEAD

Figure 6.2a: Tidal Resource Area 2



TIDAL AREA 2 – DUNCANSBY HEAD

Figure 6.2b: Tidal Resource Detail Map Area 2



PENTLAND FIRTH AND ORKNEY WATERS MSP FRAMEWORK AND LOCATIONAL GUIDANCE
Fig: Tidal Resources Details
Area - 2

Legend

- UK Land
- Strategic Area of Interest
- Bathy Contours, m
 - 10
 - 20
 - 30
 - 50
 - 100
- Bird Conservation Value >50
- Important Breeding Colonies
- Wetland Conservation (Ramsar)
- Special Areas for Conservation (SAC)
- Sites of Special Scientific Interest (SSSI)
- Special Protection Areas (SPA)
- Proposed Special Protection Areas (pSPA)
- VMS Fishing Vessels North Scotland 2007
- VMS Fishing Vessels North Scotland 2008
- Reserved
- Special Category (Fishing, Military, Sailing)
- Hi Speed Craft
- Special Category (Ports & Law)
- Passenger ship
- Cargo Ship
- Tanker
- Other vessel

Average Currents Speeds (m/s)

- 0.00 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.20
- 1.20 - 1.40
- 1.40 - 1.60
- 1.60 - 1.80
- 1.80 - 2.00
- 2.00 - 2.50

Date: March 1, 2010
 Projection: British National Grid
 Spheroid: Airy 1830
 Datum: D_OGCR_1936
 Data Source: CE, OS, SeaZone, SEPA, JNCC, SNH
 File Reference: J:\P1199\Med\Resources\Details\Fig_Tidal_Resources_Area-1.mxd
 Produced By: Hannah Galgale
 Reviewed By: David Wotherspoon

AECOM **METOC**

0 0.150.3 0.6 0.9 1.2 Km

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TIDAL AREA 3 – PENTLAND FIRTH OUTER SOUND

SUMMARY

This area has the largest raw resource opportunity for tidal development, but also has some significant challenges to capture this energy. The area is currently largely excluded from the initial Crown Estate licensing round for the Pentland Firth. Surface piercing devices will conflict with the ferry route which runs from Gills Bay to St Margaret's Hope on South Ronaldsay and the commercial shipping (predominantly tankers and cargo vessels) and fishing vessels that transit east-west through the Pentland Firth. Any submerged or seabed position tidal developments in this area will also require agreement on adequate clearance for vessel passage. The amount of clearance required must be formalised through a national level agreement between shipping interests and tidal energy interests, with 10m clearance being a possible starting point.

Given the significant challenges associated with vessel movement in this area, the majority of this area has been indicated as a potential area of opportunity, as it requires agreement with shipping and navigation interests which cannot be resolved at this stage of the Marine Spatial Plan. Key issues to be addressed are:

- potential co-use with seabed based devices
- clearance requirements over the top of any seabed devices
- potential introduction of new shipping control measures to allow placement of surface piercing devices

RESOURCE

The Outer Sound is a complex area, with strong tidal currents, races and eddies all present. Depths of 60m to 80m are typical. The Admiralty Pilot and charts notes east going steams of up to 9 knots (~4.6 m/s) and west going streams of 8 knots (~4.1 m/s).

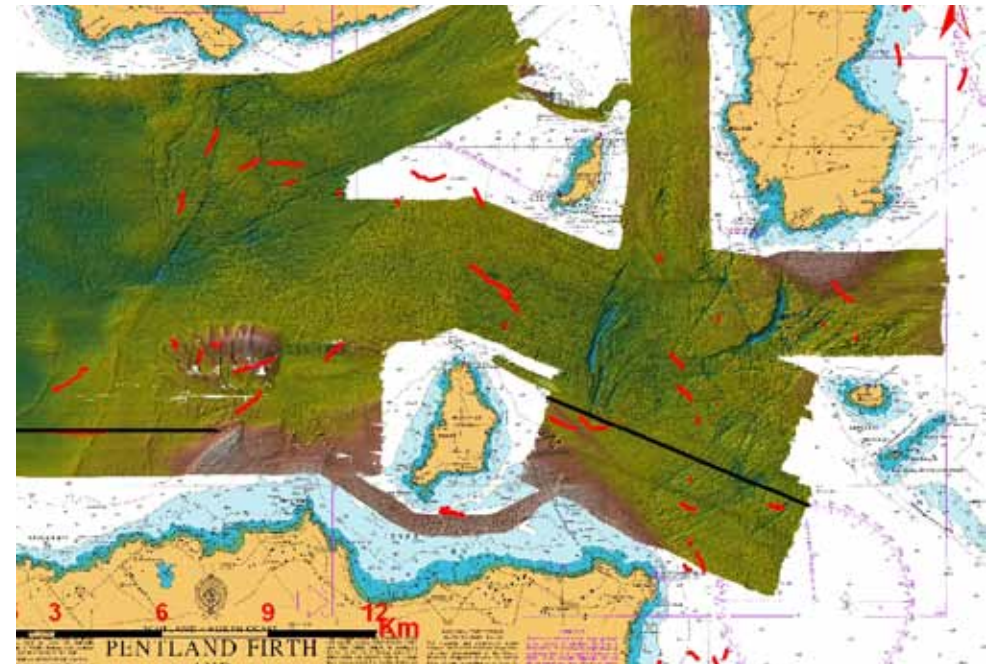
The western part of this area contains the Merry Men of Mey tidal race. The Swilkie exists of Silkie Point at the north end of Stroma and races also form at the south (and north) end of Swona. Eddies form either side of both Stroma and Swona, leading to the formation of sandbanks in the lee of the islands.

BATHYMETRY AND SEABED

The Outer Sound in this area is approximately 75m deep to the east of the Merry Men of Mey, with depths of 80m to 90m in the area of the tidal race and to the west of it.

Recent seabed surveys in the area by Marine Scotland Science show the seabed to be folded and fractured, with significant faults running SSW from Brims Ness and also E-W in mid channel.

Diagram:6.1: Seabed Survey: Pentland Firth and Outer Sound



Sediment deposits are present to the east and west of Stroma, formed by the eddy currents from the island.

TIDAL AREA 3 – PENTLAND FIRTH OUTER SOUND

SHIPPING

The Gills Bay – St. Margaret's Hope ferry runs north-south through this area, traversing either side of Stroma and Swona as required. The AIS data shows that the ferry route can vary over a wide area, depending on the tidal state and weather conditions.

Tankers, cargo vessels and other shipping traverse east-west through the Pentland Firth and the area between South Walls and Swona forms part of the recommended track for tankers entering Scapa Flow from the west.

Fishing vessels transit through the Outer Sound on an east-west path.

FISHING

This area may also support lobster, brown and velvet crab and pot fishing.

Fishing vessels transit through the area. Indicative fishing data (vessels operating at <4knots) suggest that little or no commercial fishing effort from these larger vessels is undertaken in this area.

There is likely to be an effect on fishing activity via the introduction of marine energy developments in this area through displacement and/or exclusion from areas. The key interaction is likely to be with smaller fishing vessels utilised for the lobster and crab fishing.

MARICULTURE

No mariculture sites are located within this area.

ENVIRONMENTAL FEATURES

This area is surrounded by the SPAs at Stroma, Swona and Hoy described in previous sections and will require the same level of consideration for potential impacts on bird species in the area.

Marine species such as Minke whale, white-beaked dolphin and harbour porpoise have been observed within the area or on either side of the Pentland Firth. There is a general lack of data on cetaceans and consideration will have to

be given to potential impacts from developments and potential survey and monitoring requirements.

Harbour and grey seals (EC Habitats Directive Annex II and UKBAP species) are also present in the study area. Grey seals and harbour seals are the most frequently observed species, both of which can be found on Stroma. For grey seals in particular, the island is an important breeding site with approximately 650 pups born each year (Barne *et al.*, 1996).

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips (including to Stroma) to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. The RYA has recreational sailing routes through this area.

Land based tourism in the area is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include: walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest.

Tourism contributes significantly to the area's economy.

CULTURAL HERITAGE

There are a number of live wrecks within this area, particularly around Swona and off Brims Ness, but no significant issues are envisaged.

Scheduled Ancient Monuments (SAMs) protected under the Ancient Monuments and Archaeological Areas Act 1979. Pastmap (2009) indicates that there is a SAM on Swona - a broch at Greenhill of Hestiegeo on the south coast of the island.

Further sites of interest on Swona include national monuments such as St Peters Chapel and a number of mounds, cairns and remains of structures as well as Swona lighthouse.

There are also four SAMs on Stroma, including a chambered cairn near the lighthouse at the north of the island.

TIDAL AREA 3 – PENTLAND FIRTH OUTER SOUND

EXISTING INFRASTRUCTURE

No other seabed infrastructure is present in this area.

PORTS AND HARBOURS

This area can be served by a number of harbours.

To the west of the area is the port of Scrabster which is frequented by fishing vessels, ferries and some cargo vessels. Scrabster Harbour Trust has plans to develop the harbour to service the marine renewables industry.

To the north is the sheltered anchorage of Scapa Flow and the facilities at Lyness, for which Orkney Island Council also have plans to develop further to service the marine renewables industry.

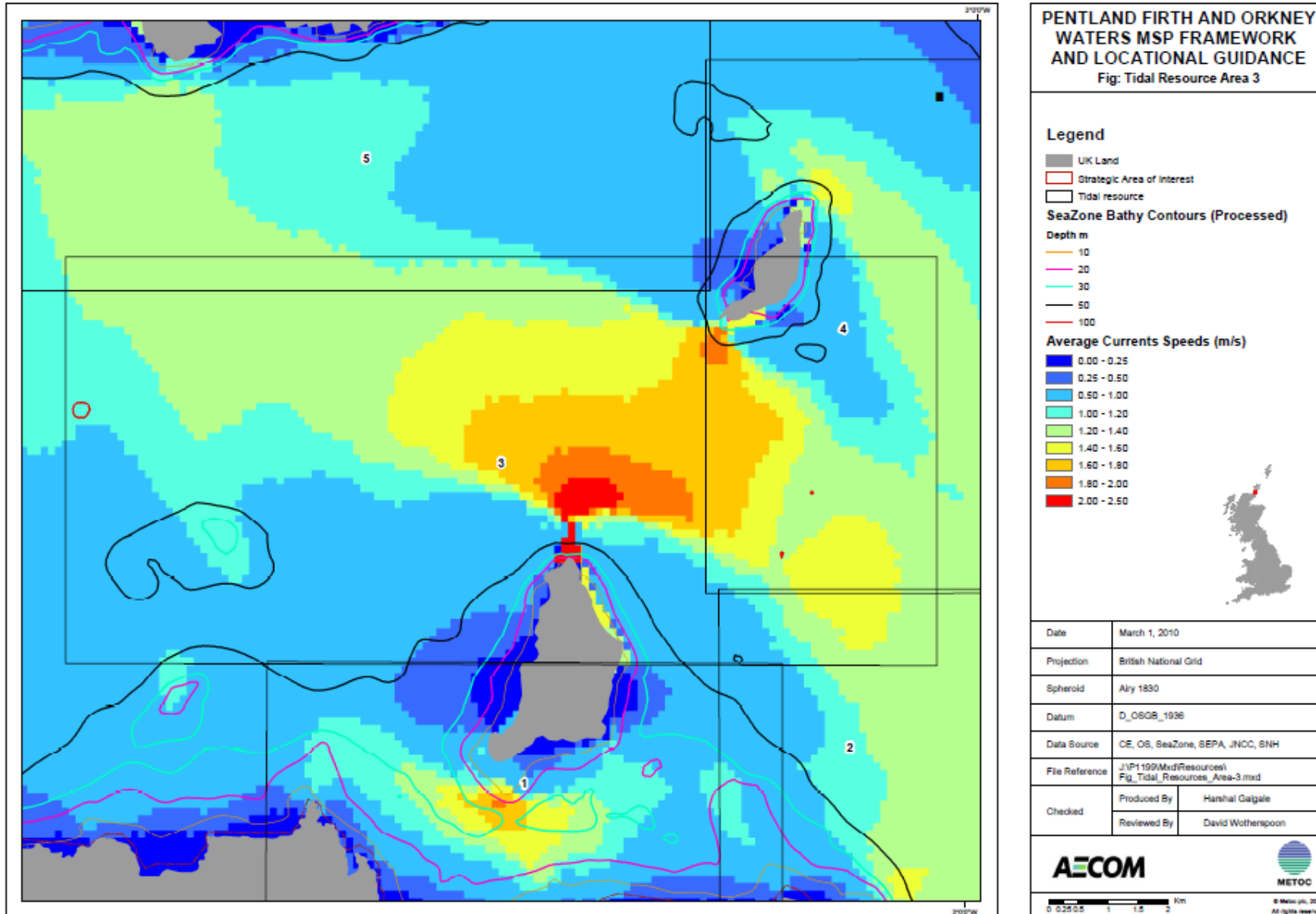
The north-western part of this area, adjacent to Swona, falls within the limit of the Orkney Harbour Authority, from whom Harbours Works Act permission will be required for any development in this area.

OTHER USERS

Military activities occur across a large portion of the Pentland Firth and this area lies entirely within an existing military practice area. The area is not however located in an area designated as a 'danger area' or a 'byelawed' area which have been designated by the MOD as typically marine renewable energy development 'no-go areas'.

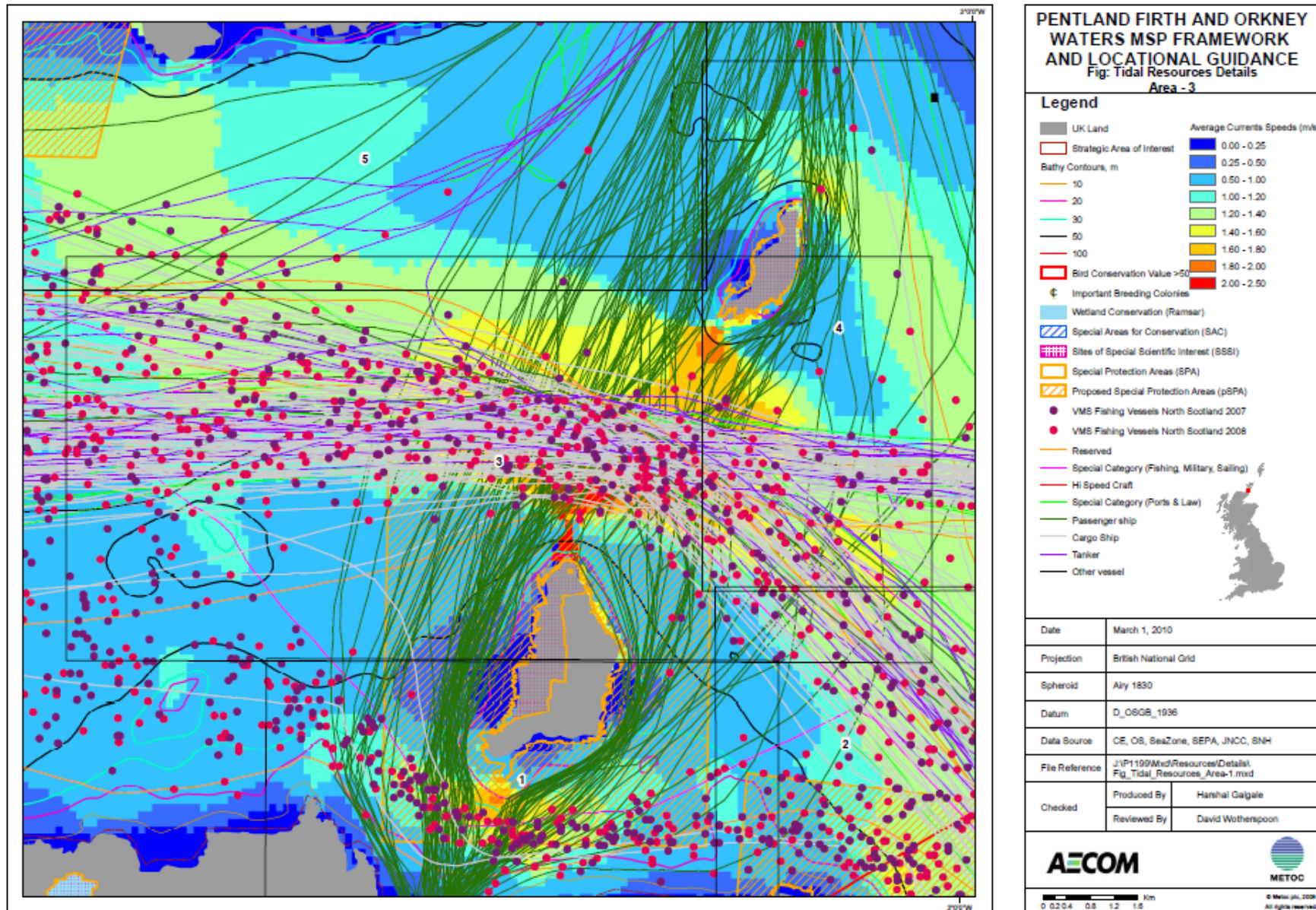
TIDAL AREA 3 – PENTLAND FIRTH OUTER SOUND

Figure 6.3a: Tidal Resource Area 3



TIDAL AREA 3 – PENTLAND FIRTH OUTER SOUND

Figure 6.3b: Tidal Resource Detail Map Area 3



TIDAL AREA 4 – SWONA AND SOUTH RONALDSAY

SUMMARY

This area has a large raw resource opportunity for tidal development, but also has some significant challenges to capture this energy. Surface piercing devices will conflict with the ferry route which runs from Gills Bay to St Margaret's Hope on South Ronaldsay and the commercial shipping (predominantly tankers and cargo vessels) and fishing vessels that transit east-west through the Pentland Firth. The channel between Swona and South Ronaldsay is also the recommended track for any tankers proceeding to or from the Flotta Oil terminal in Scapa Flow from or to the east. Any submerged or seabed positioned tidal developments in this area will also require agreement on adequate clearance for vessel passage. The amount of clearance required must be formalised through a national level agreement between shipping interests and tidal energy interests, with 10m clearance being a possible starting point.

Given the challenges associated with vessel movement in this area, the majority of this area has been indicated as a potential area of opportunity, as it requires agreement with shipping and navigation interests which cannot be resolved at this stage of the Marine Spatial Plan. Areas already identified in zone 3 are not repeated in the overlapping area. Key issues to be addressed are:

- potential co-use with seabed based devices
- clearance requirements over the top of any seabed devices
- potential introduction of new shipping control measures to allow placement of surface piercing devices.

RESOURCE

The channel between Swona and South Ronaldsay, with general depths of 60m to 70m, has spring rates of 4ms^{-1} on the eastern side. Swona itself causes extensive eddies to its east during the east-going flood tide, and similarly to its west during the ebb. There are also significant tidal races both north and south of the island, as there are to the south of South Ronaldsay. The presence of the eddies and races is likely to cause an asymmetry in the tidal currents from the east going to the west going stream, both in location and strength of current.

The race of Lother Rock at the south-west of South Ronaldsay and the Liddel Eddy between South Ronaldsay and Muckle Skerry will be challenging for potential deployments in these areas.

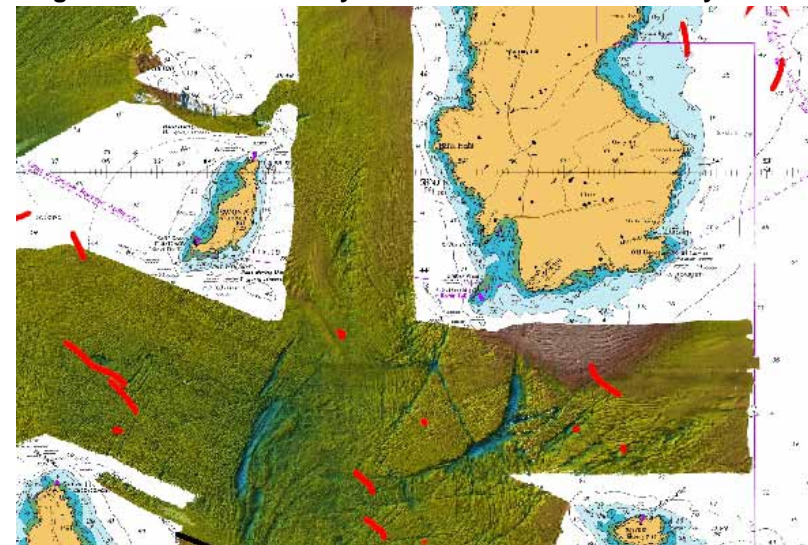
BATHYMETRY AND SEABED

The southern part of this zone has depths of 60m to 75m in the main channel. The southern part of South Ronaldsay shelves quickly to 30m, reaching 50m at the location of the Liddel Eddy.

The coast around Swona drops very quickly to 50m, with the channel between Swona and South Ronaldsay being 60m to 70m in depth.

Recent seabed surveys in the area by Marine Scotland Science do not cover the area close inshore, but show with significant faults and fractures SW of South Ronaldsay and south of Swona. Deployment in these fault zones would be very problematic for seabed foundations.

Diagram 6.2: Seabed Survey: Swona and South Ronaldsay



SHIPPING

The Gills Bay – St. Margaret's Hope ferry runs north-south through this area, traversing either side of Stroma and Swona as required. The AIS data shows that the ferry route can vary over a wide area, depending on the tidal state and weather conditions.

TIDAL AREA 4 – SWONA AND SOUTH RONALDSAY

Tankers, cargo vessels and other shipping traverse east-west through the Pentland Firth diverge at the western end of this zone – some travelling in a NW-SE direction to and from Duncansby Head area to the North Sea and others continuing their E-W track across the North Sea.

Fishing vessels use the same two distinct tracks as the commercial shipping noted above.

FISHING

This area may also support lobster, brown and velvet crab and pot fishing.

Fishing vessels transit through the area. Indicative fishing data (vessels operating at <4knots) suggest that little or no commercial fishing effort from these larger vessels is undertaken in this area.

There is likely to be an effect on fishing activity via the introduction of marine energy developments in this area through displacement and/or exclusion from areas. The key interaction is likely to be with smaller fishing vessels utilised for the lobster and crab fishing.

MARICULTURE

No mariculture sites are located within this area.

ENVIRONMENTAL FEATURES

This area interacts with the **SPAs** at Swona, Stroma and Muckle Skerry described in previous sections and will require the same level of consideration for potential impacts on bird species in the area.

Harbour and grey seals (EC Habitats Directive Annex II and UKBAP species) are also present in the study area. Grey seals and harbour seals are the most frequently observed species, both of which can be found on Stroma.

European otter have also been noted on South Ronaldsay.

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. The RYA has recreational sailing routes through this area.

Land based tourism in the area is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include: walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest.

CULTURAL HERITAGE

There are a number of live wrecks within this area, but no significant issues are envisaged.

There is a Scheduled Ancient Monument on South Ronaldsay – a chambered cairn at Isbister. There are a significant number of further sites of interest on South Ronaldsay include national monuments such as cairns, burial grounds, chapels and old settlement remains.

The cultural heritage interests on Swona have been described in previous sections and are not repeated here.

EXISTING INFRASTRUCTURE

No other seabed infrastructure is present in this area.

PORTS AND HARBOURS

This area is close to the sheltered anchorage of Scapa Flow and the facilities at Lyness, for which Orkney Island Council also have plans to develop further to service the marine renewables industry.

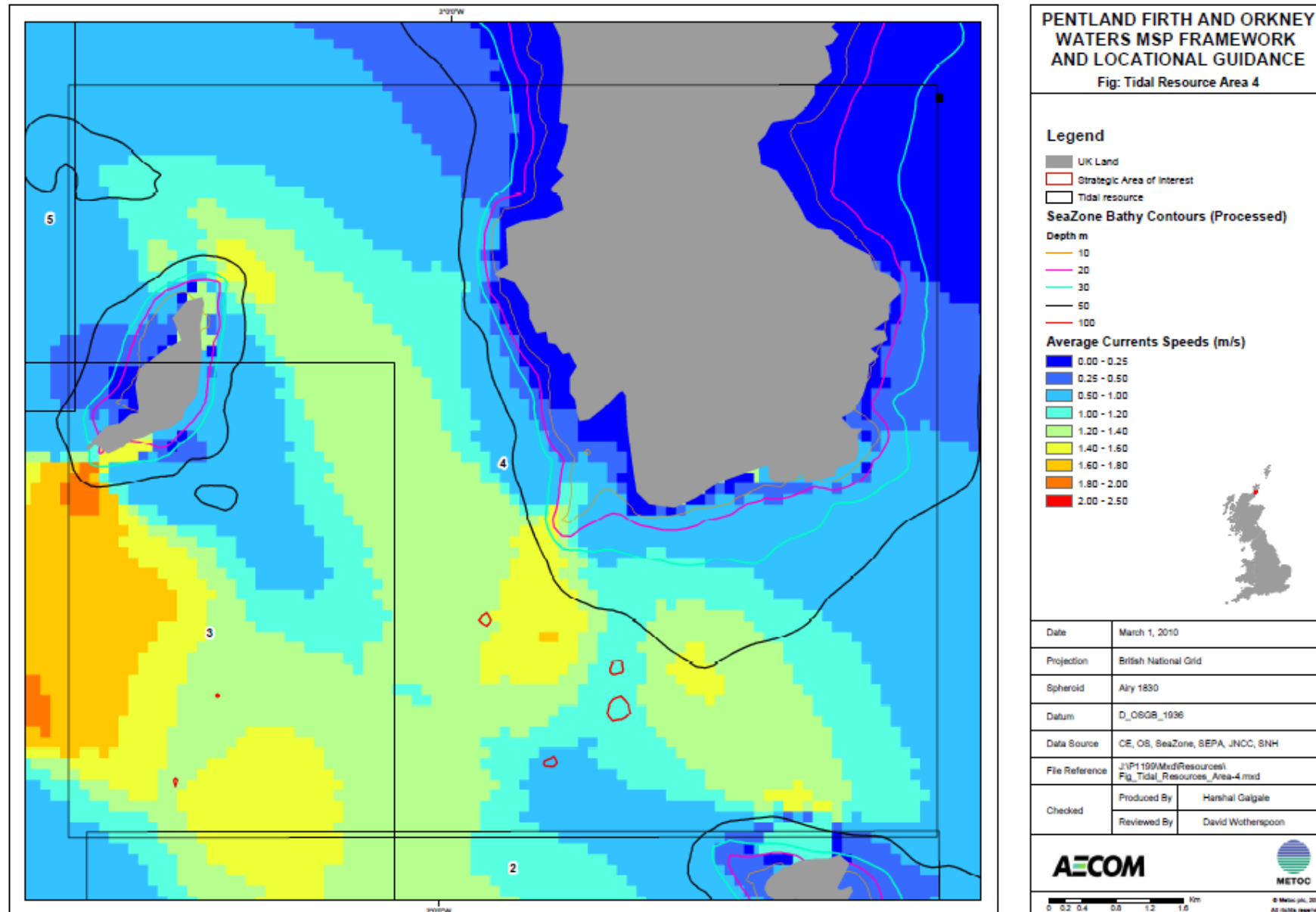
The part of this zone to the north of the southern point of Swona falls within the limit of the Orkney Harbour Authority, from whom Harbours Works Act permission will be required for any development in this area.

OTHER USERS

Military activities occur across a large portion of the Pentland Firth and this area lies entirely within an existing military practice area. The area is not however located in an area designated as a “danger area” or a “byelawed” area which have been designated by the MOD as typically marine renewable energy development “no-go areas”

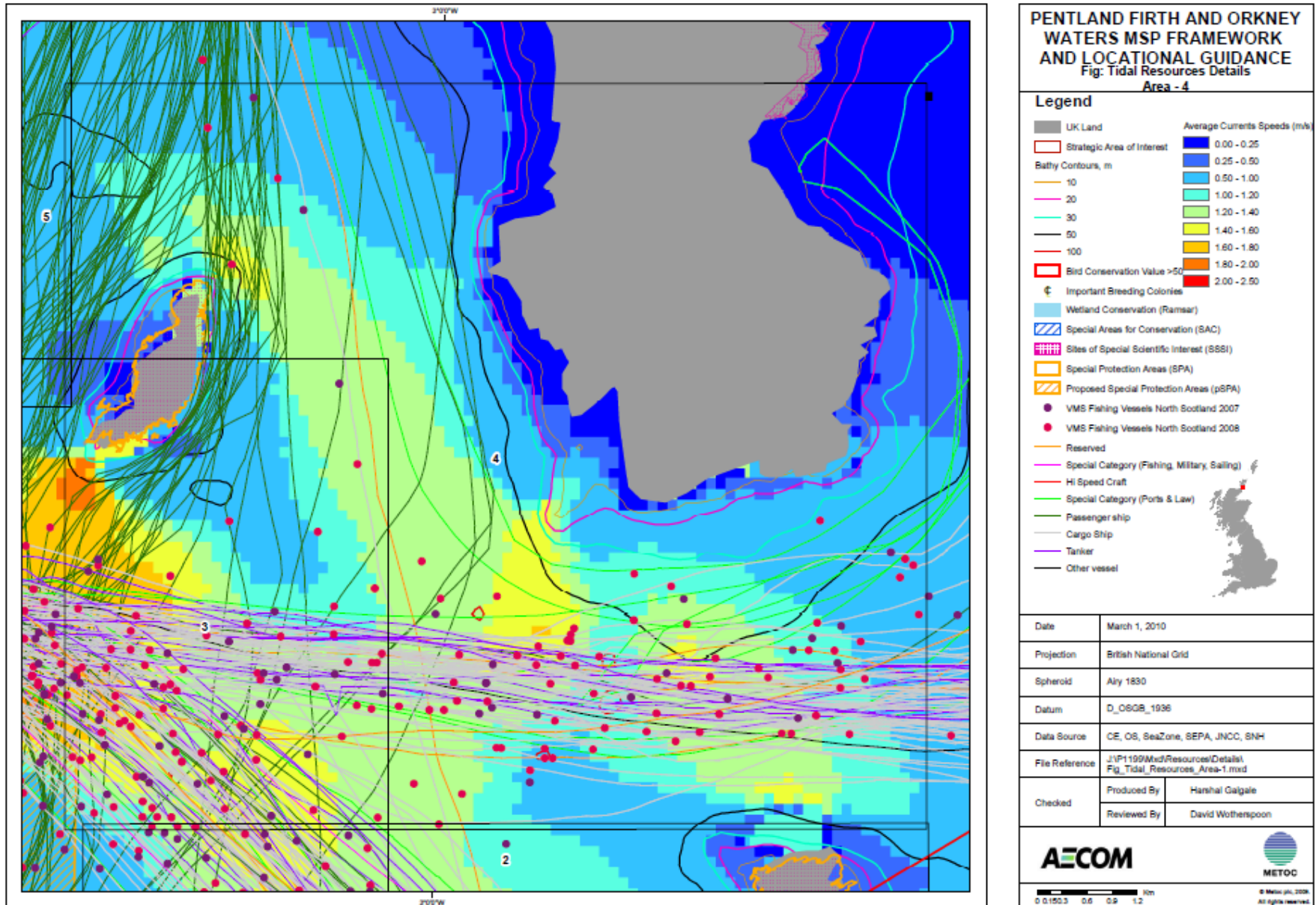
TIDAL AREA 4 – SWONA AND SOUTH RONALDSAY

Figure 6.4a: Tidal Resource Area 4



TIDAL AREA 4 – SWONA AND SOUTH RONALDSAY

Figure 6.4b: Tidal Resource Detail Map Area 4



TIDAL AREA 5 – SOUTH HOY & SOUTH WALLS

SUMMARY

This area has a large raw resource opportunity for tidal development, but also has some significant challenges to capture this energy. Surface piercing devices will conflict with the ferry route which runs from Gills Bay to St Margaret's Hope on South Ronaldsay at the eastern end of this zone.

The commercial shipping (predominantly tankers and cargo vessels) and fishing vessels that transit east-west through the Pentland Firth do so predominantly to the south of this zone. However, the channel between South Walls and Swona is the recommended track for any tankers proceeding to or from the Flotta Oil terminal in Scapa Flow from or to the west. Any submerged or seabed positioned tidal developments in this area will also require agreement on adequate clearance for vessel passage. The amount of clearance required must be formalised through a national level agreement between shipping interests and tidal energy interests, with 10m clearance being a possible starting point.

Given the challenges associated with vessel movement in this area it has been defined in two parts – an inshore area of opportunity which can be developed with minor modifications to shipping routing or adequate navigational controls, and a potential area of opportunity which will require agreement with shipping and navigation interests which cannot be resolved at this stage of the Marine Spatial Plan. Areas already identified in adjacent zones are not repeated in the overlapping area. Key issues to be addressed are:

- potential co-use with seabed based devices
- clearance requirements over the top of any seabed devices
- potential introduction of new shipping control measures to allow placement of surface piercing devices.
- Development requirements/projections for the container transshipment hub

RESOURCE

Tidal streams of 3 – 3.5 m/s are present in this area, with an eddy forming offshore of South Walls.

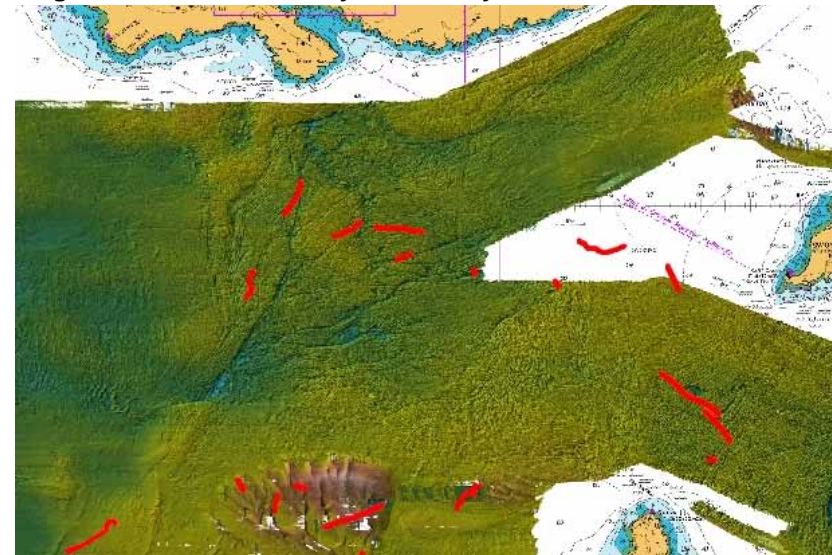
The western end of this zone encompasses the northern end of the Merry Men of Mey tidal race.

BATHYMETRY AND SEABED

The area immediately to the south of Hoy and South Walls falls quickly to 50m and then shelves to around 80m.

The seabed survey recently carried out by Marine Scotland Science, though incomplete in the nearshore areas, shows folded, fractured and faulted bedrock to the south of Brims Ness.

Diagram 6.3: Seabed Survey: South Hoy and South Walls



SHIPPING

The Gills Bay – St. Margaret's Hope ferry runs north-south through the eastern part of this area, traversing either side of Stroma and Swona as required. The AIS data shows that the ferry route can vary over a wide area, depending on the tidal state and weather conditions.

This area is less heavily trafficked than other zones, with tankers and passenger vessels heading into Scapa Flow through the South Walls-Swona recommended track being evident. The majority of vessels passing through the Pentland Firth do so predominantly to the south of this zone.

TIDAL AREA 5 – SOUTH HOY & SOUTH WALLS

FISHING

This area supports lobster, brown and velvet crab and pot fishing. Scallops are also thought to be collected in Aith Hope

Fishing vessels transit through the area. Indicative fishing data (vessels operating at <4knots) suggest that little or no commercial fishing effort from these larger vessels is undertaken in this area.

There is likely to be an effect on fishing activity via the introduction of marine energy developments in this area through displacement and/or exclusion from areas. The key interaction is likely to be with smaller fishing vessels utilised for the lobster and crab fishing.

MARICULTURE

There is a finfish farm recorded in Aith Hope, but no activity takes place in the more exposed coastal shore area of interest for tidal development. Locations of any tidal development along this shoreline should preserve access into Aith Hope.

ENVIRONMENTAL FEATURES

The Hoy SPAs eastern edge is between Tor Ness and Brims Ness. Hoy SPA covers the northern and western two-thirds of Hoy island, which is formed of Old Red Sandstone and contains Orkney's highest hills, and adjacent coastal waters. The SPA supports an extremely diverse mixture of mire, heath and alpine vegetation and Britain's most northerly native woodland. These upland areas and the high sea cliffs at the coast support an important assemblage of moorland breeding birds and breeding seabirds.

The boundary of Hoy SPA overlaps with that of Hoy SSSI and SAC, and the seaward extension extends approximately 2 km into the marine environment to include the seabed, water column and surface.

As well as the general assemblage of breeding seabirds, specific qualifying species include Arctic skua, fulmar, great black-backed gull, great skua, guillemot, kittiwake, peregrine, puffin and red-throated diver.

Bordering this area is the SPA and SSSI on Switha (non-breeding Greenland barnacle goose) to the north and the SPA's and SSI's on Swona and Stroma to the east, described in previous sections.

Harbour and grey seals (EC Habitats Directive Annex II and UKBAP species) are also present in the study area. Grey seals and harbour seals are the most frequently observed species, both of which can be found on Stroma. European Otter have also been recorded on Switha.

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. The RYA has recreational sailing routes through this area.

Land based tourism in the area is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include: walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest.

CULTURAL HERITAGE

There are a number of live wrecks off Brims Ness and Cantick Head including 19th century barques, schooners and smacks. No significant issues are envisaged as these areas can be avoided in development phases.

There are a number of Scheduled Ancient Monuments in this area – a chapel and a broch near Brims Ness and another broch on South Walls.

There are a significant number of further sites of interest in this southern part of Hoy and South Walls including national monuments such as cairns, burial grounds, old settlement remains and more recent 20th century wartime establishments.

EXISTING INFRASTRUCTURE

No other seabed infrastructure is present in this area.

TIDAL AREA 5 – SOUTH HOY & SOUTH WALLS

PORTS AND HARBOURS

This area is close to the sheltered anchorage of Scapa Flow and the facilities at Lyness, for which Orkney Island Council also have plans to develop further to service the marine renewables industry.

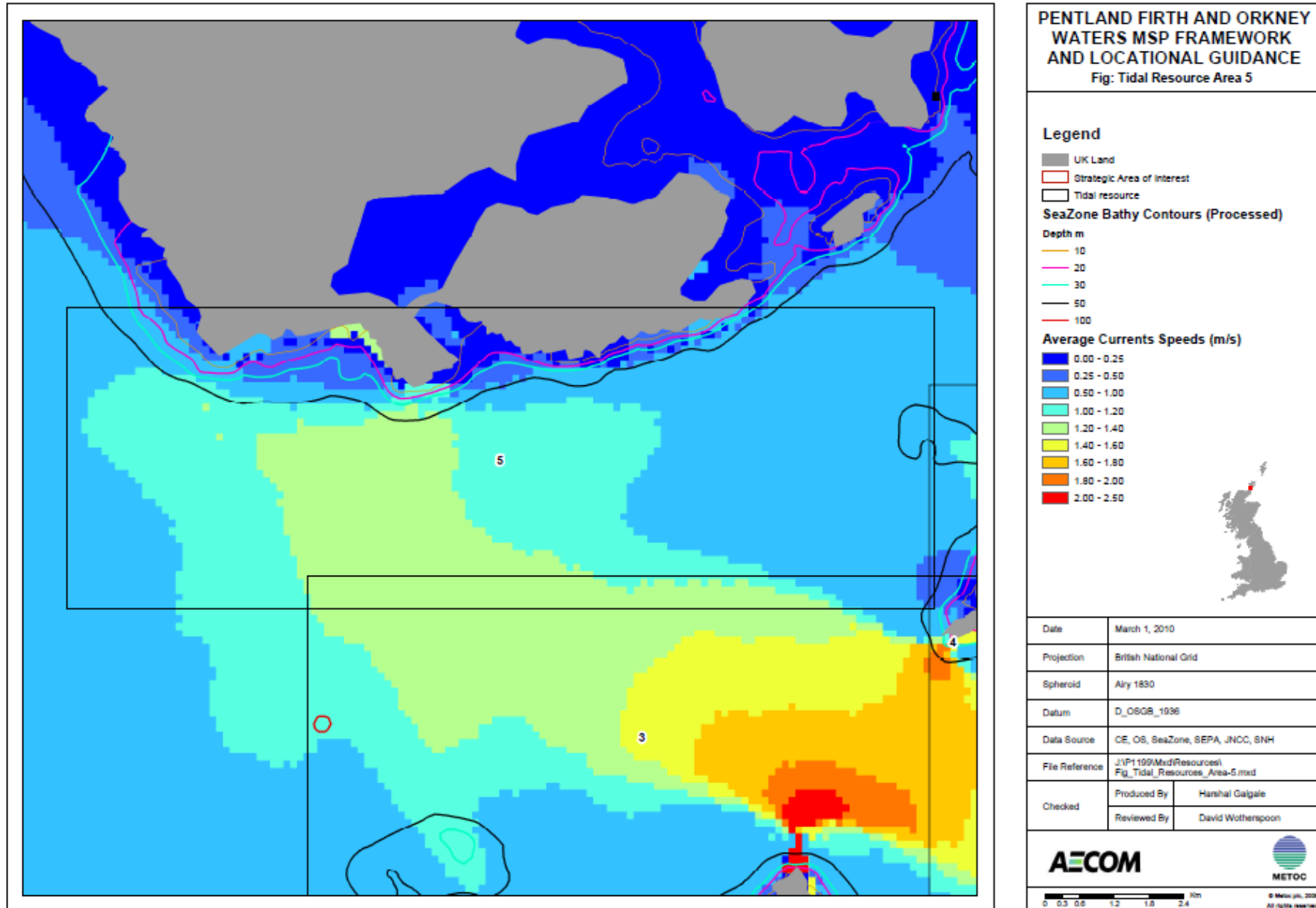
The part of this zone, between Brims Ness and the southern point of Swona falls within the limit of the Orkney Harbour Authority, from whom Harbours Works Act permission will be required for any development in this area.

OTHER USERS

Military activities occur across a large portion of the Pentland Firth and this area lies entirely within an existing military practice area. The area is not however located in an area designated as a 'danger area' or a 'byelawed' area which have been designated by the MOD as typically marine renewable energy development 'no-go areas'.

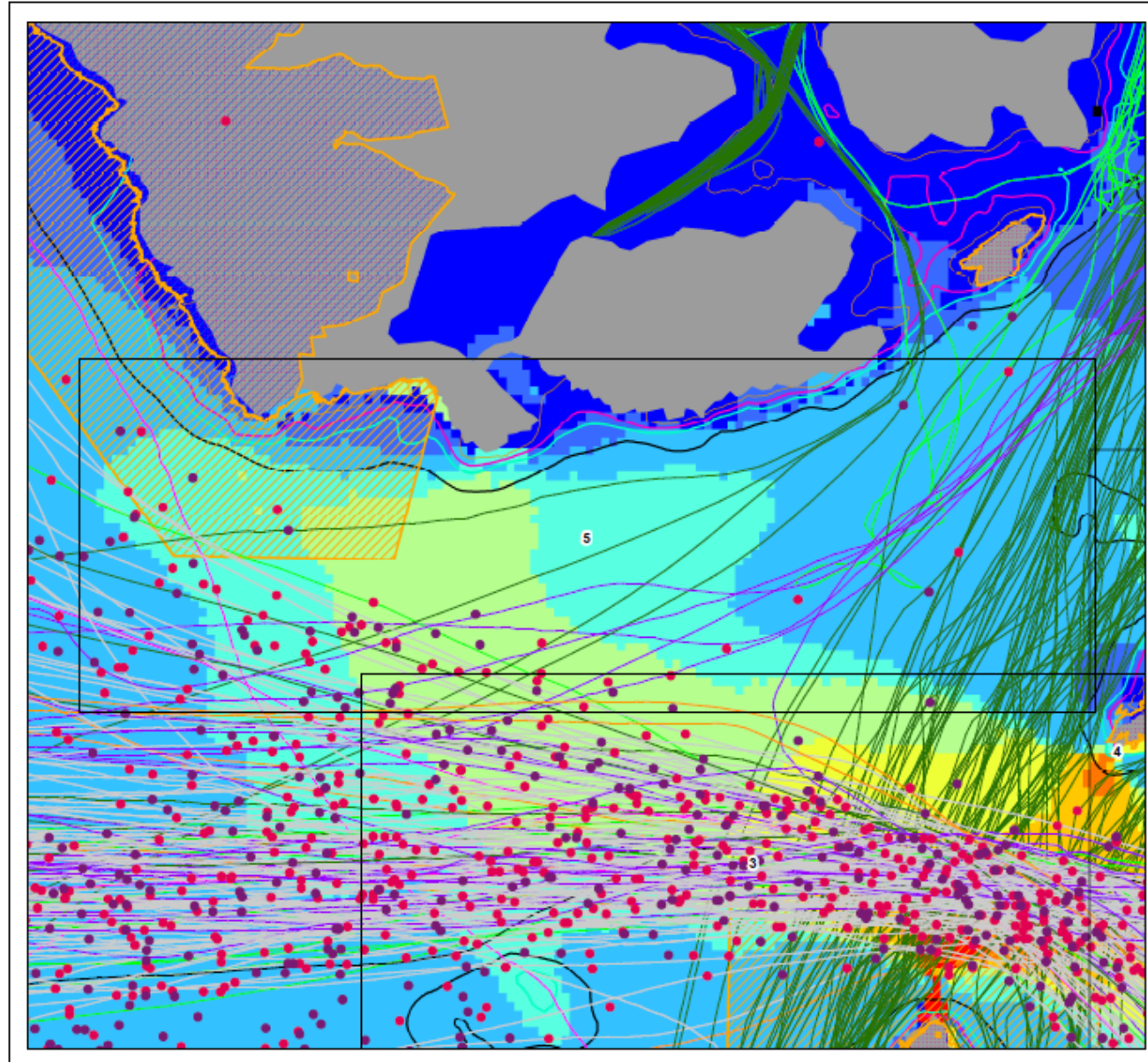
TIDAL AREA 5 – SOUTH HOY & SOUTH WALLS

Figure 6.5a: Tidal Resource Area 5



TIDAL AREA 5 – SOUTH HOY & SOUTH WALLS

Figure 6.5b: Tidal Resource Detail Map Area 5



TIDAL AREA 6 – GRAEMSAY (HOY SOUND AND BURRA SOUND)

SUMMARY

This area was initially examined as an area of opportunity as there is a potentially viable resource area in Hoy Sound and Burra Sound. However, the water depths in this area are too shallow, typically less than 20m, to accommodate even seabed mounted devices to maintain sufficient clearance for vessel movement.

Technology may emerge with very low vertical profiles to exploit this area in future, but within the current forward view of this MSP, no obvious technology opportunities are present which would allow this to happen without significant effects on vessel movements in and out of Stromness.

This area is therefore not recommended for designation as a tidal development area during the current timeframe for the MSP.

RESOURCE

In the region of Hoy Mouth, a spring rate of 2 – 2.5 m/s is present in around 25m of water. The incoming stream splits north and south of Graemsay. In the narrows north of Graemsay, a spring rate of 4.4m/s exists (2.5m/s on neaps) in shallow waters of around 10m. Burra Sound has streams of approximately 2.3 to 2.8 m/s, but again in shallow waters of around 10m.

BATHYMETRY AND SEABED

There is a lack of information on the surface geology for this area. Hoy mouth shallows from 30m parallel to the Hoy/Mainland coastline to around 10m immediately west of Graemsay. The two Sounds are relatively narrow on either side of Graemsay, with drying reefs and shoals. Burra Sound is partially blocked by wrecks of block ships from the early days of World War 2.

SHIPPING

The Stromness to Scrabster ferry operates through Hoy Sound. A smaller local ferry service also operates from Stromness to Graemsay, on the north of Hoy and back to Stromness.

Fishing vessels going to and from Stromness enter and exit through Hoy Sound

FISHING

This area supports lobster, brown and velvet crab and pot fishing. Scallops are also thought to be collected in the area of Bay of Ireland.

Fishing vessels transit through Hoy Sound to and from Stromness.

MARICULTURE

Finfish farms are present in the south part of Burra Sound.

ENVIRONMENTAL FEATURES

Hoy **SPA** covers the northern and western two-thirds of Hoy island, which is formed of Old Red Sandstone and contains Orkney's highest hills, and adjacent coastal waters. The SPA supports an extremely diverse mixture of mire, heath and alpine vegetation and Britain's most northerly native woodland. These upland areas and the high sea cliffs at the coast support an important assemblage of moorland breeding birds and breeding seabirds.

The boundary of Hoy SPA overlaps with that of Hoy **SSSI** and **SAC**, and the seaward extension extends approximately 2 km into the marine environment to include the seabed, water column and surface.

As well as the general assemblage of breeding seabirds, specific qualifying species include Arctic skua, fulmar, great black-backed gull, great skua, guillemot, kittiwake, peregrine, puffin and red-throated diver.

Bordering this area is the Stromness heaths and coast SSSI. The special national and international importance of the site is chiefly in the sea cliffs and maritime heaths with their transitions to upland heath at low altitude. Throughout the site there are several colonies of the nationally scarce Scottish primrose. The site also supports small numbers of breeding Arctic and great skua and a small Arctic tern colony. A pair of peregrine breed regularly on the sea cliffs and Row Head is noted for its colonies of guillemots and kittiwakes.

The SSSI at Muckle Head and Selwick is of interest for its quaternary geology and geomorphology features.

TIDAL AREA 6 – GRAEMSAY (HOY SOUND AND BURRA SOUND)

Adjacent to this area are also SSSIs at Lochs of Harray and Stenness (non-breeding birds) and Orphir and Stennes Hills (hen harriers). The Loch of Stenness is also an SAC (inshore sublittoral sediment). The nearby Orkney Mainland Moors is also an SPA (hen harrier, red-throated diver and short-eared owl).

Harbour and grey seals (EC Habitats Directive Annex II and UKBAP species) are also present in the study area. Grey seals and harbour seals are the most frequently observed species, both of which can be found on Stroma. European otter have also been recorded in this area.

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. The RYA has recreational sailing routes through this area.

Land based tourism in the area is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include: walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest.

CULTURAL HERITAGE

The area contains a number of Scheduled Ancient Monuments, including a souterrain at Braebuster, the WW2 coast defence battery at Ness, Stromness

EXISTING INFRASTRUCTURE

A submarine water pipeline is laid across Burra Sound. Three power cables cross Hoy Sound to the south-west of Graemsay.

There are a large number of listed buildings on Hoy and in and around the Stromness area. There are also a large number of further sites of interest on in this area including national monuments such as houses, churches, brochs, mounds, cists, cairns, burial grounds, chapels and old settlement remains.

There are a number of wrecks in the area, including the previously mentioned block ships in Burra Sound, and other 18th and 19th century ships.

PORTS AND HARBOURS

This area is close to the sheltered anchorage of Scapa Flow and the facilities at Lyness, for which Orkney Island Council also have plans to develop further to service the marine renewables industry. The harbour at Stromness is immediately within this area.

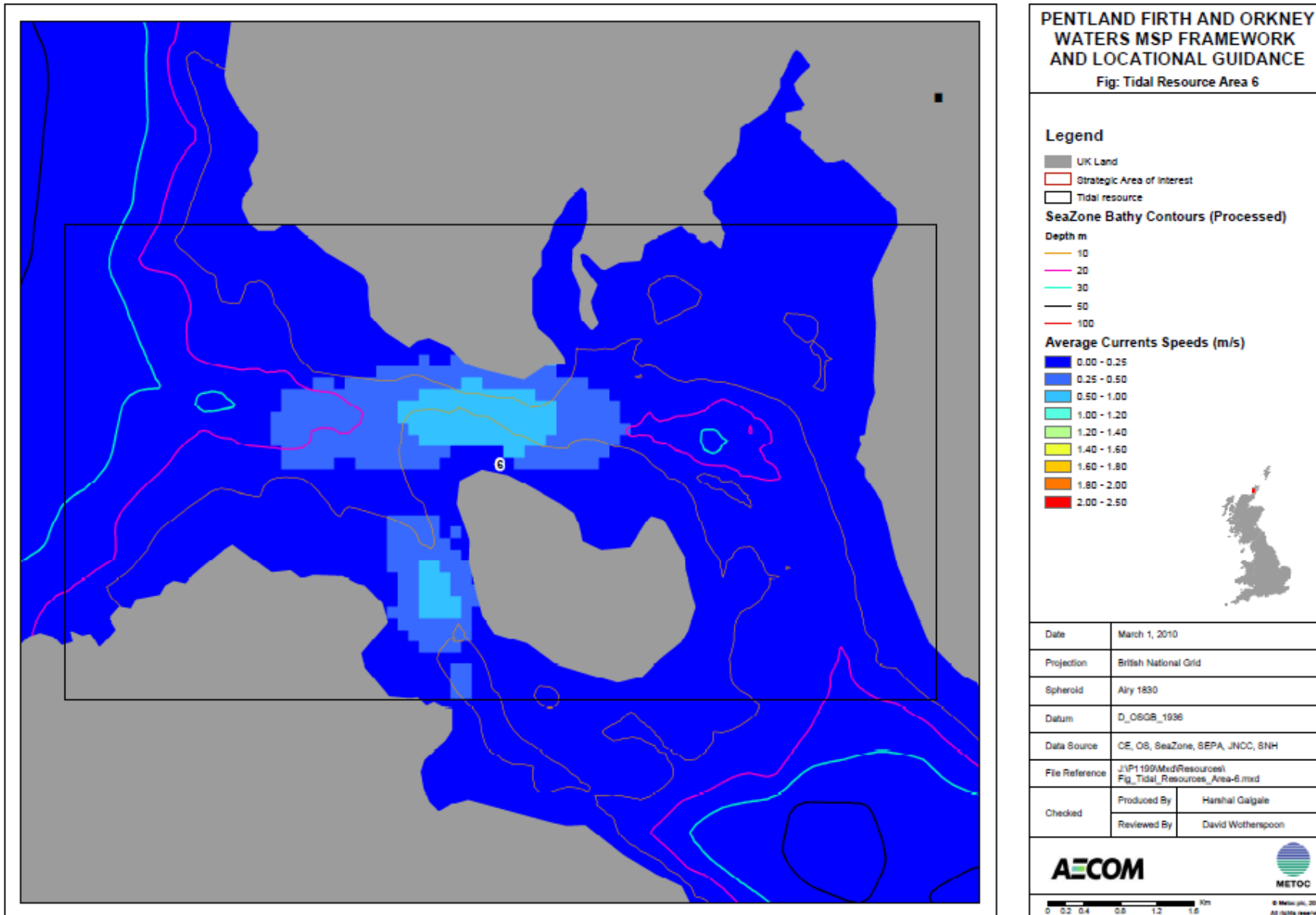
This area falls within the limit of the Orkney Harbour Authority, from whom Harbours Works Act permission will be required for any development in this area.

OTHER USERS

No other uses have been identified for this area.

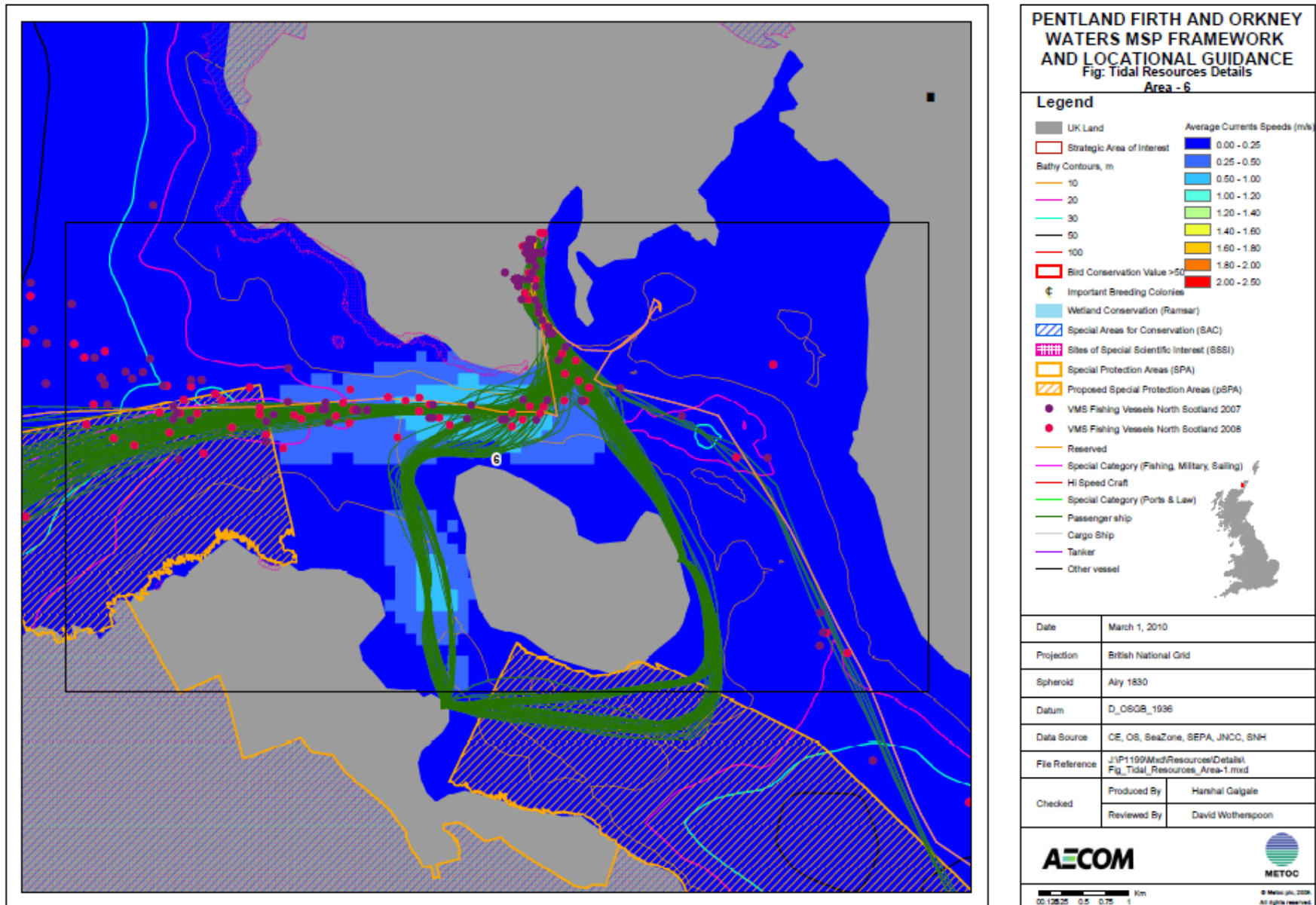
TIDAL AREA 6 – GRAEMSAY (HOY SOUND AND BURRA SOUND)

Figure 6.6a: Tidal Resource Area 6



TIDAL AREA 6 – GRAEMSAY (HOY SOUND AND BURRA SOUND)

Figure 6.6b: Tidal Resource Detail Map Area 6



TIDAL AREA 7 – WESTRAY FIRTH TO STRONSAY FIRTH

SUMMARY

The channels between the northern Orkney islands present a number of opportunities for varying scales of tidal stream development.

The Fall of Warness contains the EMEC tidal test site and vessels have been used to support EMEC related activities in this area. Fishing vessels generally transit through the firth en route to the offshore commercial fishing grounds.

The Westray Firth is the largest area of opportunity for commercial scale developments in this area. Smaller areas of resource potential exist in a number of the inter-island sounds, but may not be sufficient for commercial scale developments, both in terms of the strength and stability of the resource and the area available for development. Such areas may be suitable for community scale developments or prototype developments. EMEC is already considering “nursery” sites for part-scale testing of devices, and this MSP should not preclude any areas brought forward by EMEC for these purposes.

Significant issues in this area relate to the potential conflict with the inter-island ferries operating throughout this area. The actual areas available for development will require agreements with the shipping and navigational interests in this area regarding potential co-use of areas with submerged devices and clearance requirements. Large arrays of surface piercing devices will present significant risks to the ferry routes and could only be introduced with additional and appropriate navigational control procedures agreed. The potential resource area also coincides with the main channel through the firth used by fishing vessels.

RESOURCE

Strong tidal streams exist off War Ness at the south of Eday, but are likely to be variable in direction as different channel streams dominate at different stages of the tide.

Strong tidal streams of around 3m/s exist in the narrows at the north end of Eday Sound/ south end of Lashy Sound, although the tidal diamond in this area notes relatively weak neap tide currents, potentially making it unsuitable for commercial scale developments due to the asymmetry in potential power production.

The tidal diamond information for Westray Firth generally confirms the modelled information, with the central channel providing the main opportunity with peak spring rates of around 2.6m/s and peak neap rates of 1.1m/s between Firs Ness

on Eday and Kili Holm off Egilsay. Between War Ness and Muckle Green Holm the peak spring rate is around 3.7 m/s and the peak neap rate is 1.4 m/s. Further north in the Westray Firth, the Rull Rost tidal race forms during both tidal streams.

Smaller areas of resource potential exist in a number of the inter-island sounds, but may not be sufficient for commercial scale developments, both in terms of the strength and stability of the resource and the area available for development. Such areas include:

Eynhallow sound, which is very shallow at the western side and has a limited area where the depth is greater than 20m; The String between Shapinsay and Mainland (outwith this area to the south) and the northern end of Eday Sound.

BATHYMETRY AND SEABED

Stronsay Firth as it approaches Stronsay and Shapinsay is typically 30m to 35m deep. The coastline on these islands quickly drops to 20m before shelving to the 30m mark. At the south of Eday, the Stronsay Firth merges with the Westray Firth, Eday Sound and various channels to the west. The firth is separated from Eday Sound by an area of shallows between Veness on Eday and Rothiesholm Head on Stronsay. To the west, shallows between Egilsay and Shapinsay also delineate the main firth.

Muckle Green Holm marks the change between Stronsay Firth and Westray Firth. The main channel is again 30m to 35m as it passes between Egilsay and Eday and widens out between Rousay and Westray.

There is little information available on the seabed in this area, other than for the area around the EMEC site where bedrock is exposed in many areas, with occasional boulders. To the north and east of the deep basin there are some deposits up to 11m thick of boulders, cobbles, gravel and interstitial shelly sand, presumed to be glacial till deposits with a reworked surface layer. Dive and ROV surveys show these rocks to be well covered with flora and fauna, indicating long-term stability and minimal transport of sand or gravel. Close to shore there are sand deposits within the gullies formed by the rock ridges that run along the line of the cable route (EMEC, 2007)

TIDAL AREA 7 – WESTRAY FIRTH TO STRONSAY FIRTH

SHIPPING

The main shipping interests in this area are the inter-island ferries and fishing vessels. The AIS data illustrates the broad spread of paths taken by the ferries across the Stronsay and Westray Firth's, dependent upon operational requirements, tidal conditions and weather. The ferry routes include those to Eday, North Ronaldsay, Papa Westray, Sanday, Stronsay and Westray. In the west of this area, ferries also operate to Rousay, Egilsay and Wyre.

The Westray and Stronsay Firths are also used as a transit route for fishing vessels heading to and from the major fishing grounds north-west of the Orkney Islands.

FISHING

A large area of the main channel of the Stronsay and Westray Firths are used for whelk and pot fishing. The shallower areas outwith the main channel support lobster, brown and velvet crab, pot fishing and dredge and dive scallops.

As noted in the shipping sections, larger fishing vessels transit through Firths to and from the major offshore fishing grounds to the north-west of the Orkney Islands.

MARICULTURE

There are finfish and shellfish farms present through this area, but these are generally located in more sheltered and less energetic environments, close to shore, that that sought for tidal energy developments. Current locations include Shapinsay (Veantraw Bay), Wyre Sound, Rousay Sound and Eday Sound. St. Catherine's Bay at Stronsay is also a shellfish growing water and Bay of Tuquoy at Westray is a shellfish production area.

It is unlikely that there will be any significant direct conflict between the interests of fish and shellfish farming and the development of tidal energy sites.

ENVIRONMENTAL FEATURES

This area is adjacent to the Orkney Mainland Moors **SPA** Mainland Moorland **SSSI**. This moorland area supports hen harriers, red-throated diver and short-eared owl.

Rousay is also an **SPA** and **SSSI**. The qualifying bird species for the SPA are Arctic skua, Arctic tern, fulmar, guillemot and kittiwake. These species are also present in the West Westray SPA, along with razorbill.

The Calf of Eday **SPA** and **SSSI** has qualifying populations of cormorant, fulmar, great black-backed gull, guillemot and kittiwake

Doomy and Whitemaw Hill **SSSI** contains Orkney's only regularly breeding whimbrel as well as Arctic skuas.

Red-throated diver is the notified feature for the Mill Loch, Eday **SSSI**.

The Eynhallow **SSSI** contains a variety of breeding birds, including fulmars, great black-backed gull, herring gull, common gull, Arctic skua, great skua, Arctic tern, puffin, black guillemot, eider duck, lapwing and oystercatchers. Eynhallow is also one of the most important harbour seal breeding and haul-out sites in Orkney.

Faray and Holm of Faray are designated as an **SAC** for grey seal. Grey seal are also the notified feature for the Muckle and Little Green Holm **SSSI**

The environmental description for EMEC notes that that otters are present on Eday and Faray. Harbour seals and grey seals range throughout the Orkney Islands, and there are number of haulout sites through this area including Seal Skerry; along the south-west coast of Eday; just east of The Graand on Eday's south coast and on Muckle and Little Green Holm. Muckle Green Holm and Little Green Holm also act as a haul-out area during the summer for grey seals, as to a lesser extent does Seal Skerry.

Other marine mammals that have been noted throughout the broader area of the northern Orkney Isles include harbour porpoise, killer whales, Minke whales, pilot whales, pilot whale and white beaked dolphin.

Leatherback turtles have also been noted in the northern Orkney Islands.

The abundance of bird and marine mammal wildlife in this area mean that potential cumulative effects from large arrays of tidal energy generators would be of concern. It is likely that this area could only be developed under an adaptive

TIDAL AREA 7 – WESTRAY FIRTH TO STRONSAY FIRTH

management programme to ensure that information from initial development stages are assessed for potential effects before further development takes place.

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. The RYA has recreational sailing routes through this area.

Land based tourism in the area is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include: walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest.

CULTURAL HERITAGE

This area contains a large number of Scheduled Ancient Monuments (SAMs), listed buildings and features of interest for the National Monuments Record of Scotland, too many to summarise here.

The SAMs include cairns, churches, chapels, brochs, chambered tombs, mounds, dykes and standing stones.

Wrecks in the area include 19th and 20th century vessels, with a variety of luggers, barques, schooners, smacks and sloops.

The extensive historical and archaeological interests in this area will need to be carefully considered when planning any land based infrastructure for potential development. As well as wrecks within this area, submerged archaeology may also be of potential interest and should be considered in development planning.

EXISTING INFRASTRUCTURE

There are a number of inter-island submarine electricity cables laid throughout this area, all marked on admiralty charts.

Existing onshore grid is weak and upgrades will be required to allow export of electricity produced from development areas.

PORTS AND HARBOURS

This area falls within the limit of the Orkney Harbour Authority, from whom Harbours Works Act permission will be required for any development in this area.

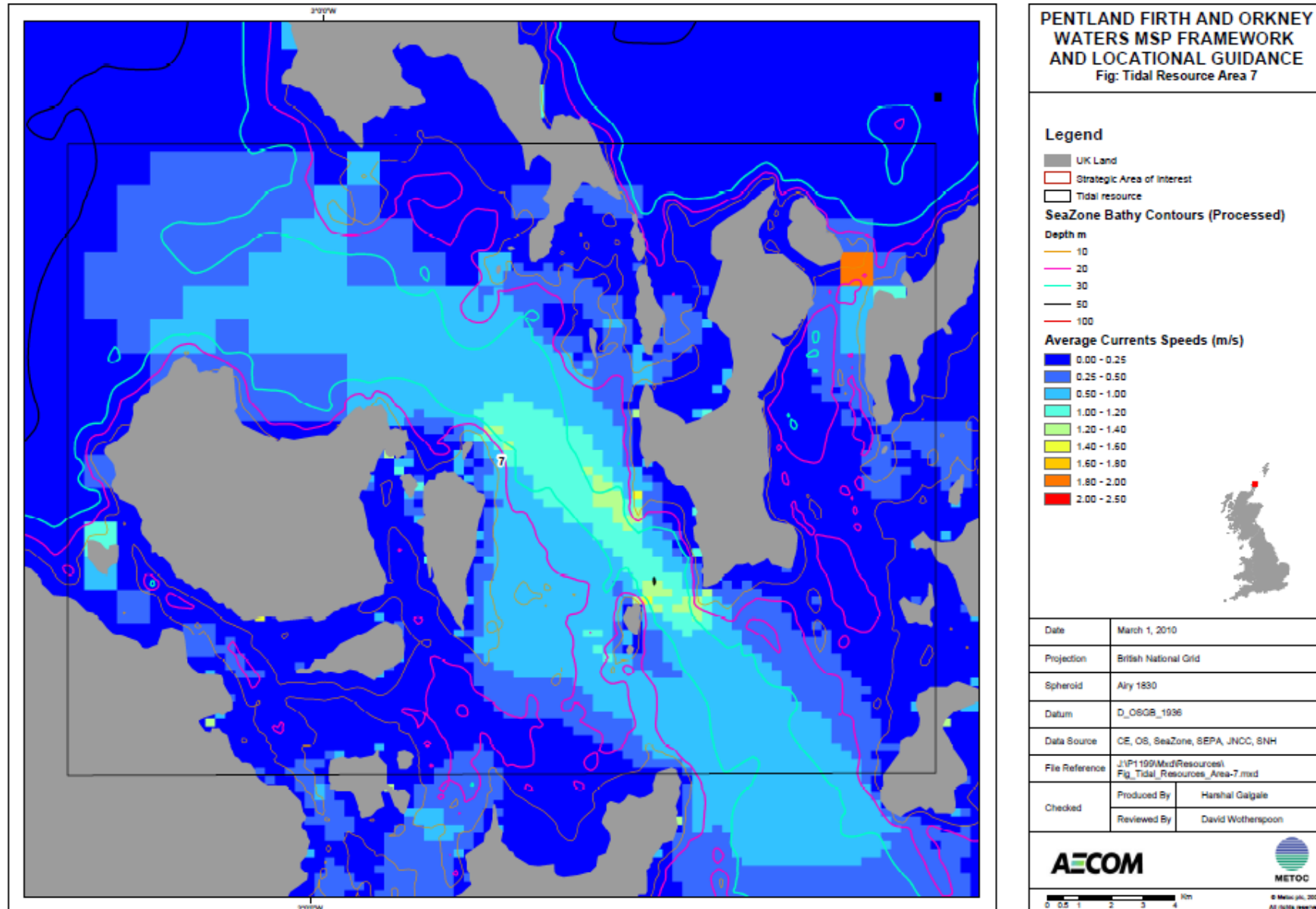
There are a number of piers and terminals throughout this area servicing the inter-island ferries. Kirkwall is the closest large harbour facility for this area.

OTHER USERS

No other uses have been identified for this area.

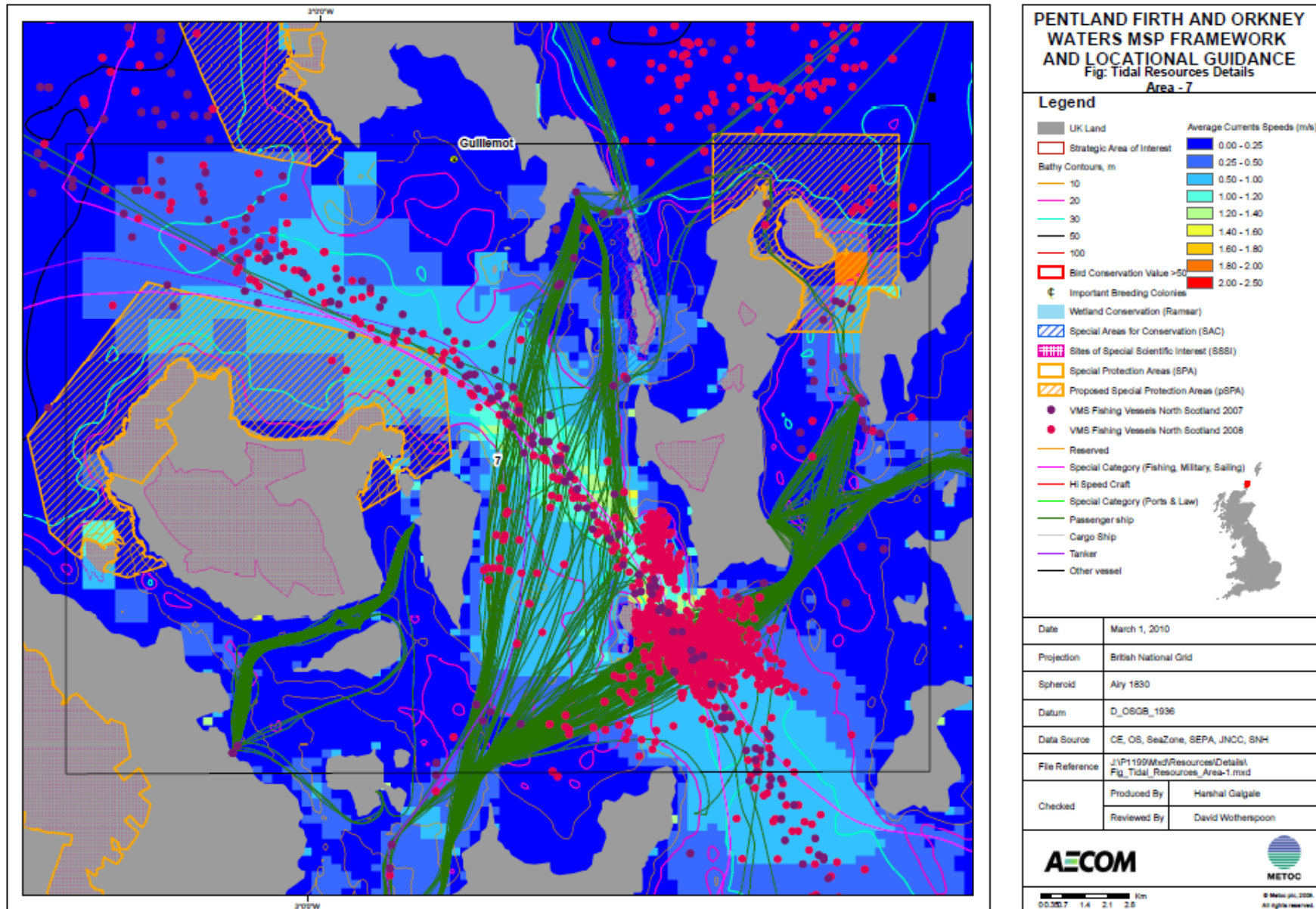
TIDAL AREA 7 – WESTRAY FIRTH TO STRONSAY FIRTH

Figure 6.7a: Tidal Resource Area 7



TIDAL AREA 7 – WESTRAY FIRTH TO STRONSAY FIRTH

Figure 6.7b: Tidal Resource Detail Map Area 7



TIDAL AREA 8 – PAPA WESTRAY (MULL HEAD)

SUMMARY

Papa Westray is one of Orkney's smallest isles lying some 20 miles north of Kirkwall. Just 4 miles long by 1 mile wide and a population of approximately 75.

The area at the north of the island, off Mull Head, is a potential tidal resource area. Data on the resource is currently too coarse to confirm if it is viable for commercial scale developments. The resource would have to be confirmed through on site measurements.

RESOURCE

The Admiralty chart and Admiralty Pilot note currents of around 2.5 to 3 m/s off Mull Head, but diminish in strength with distance offshore.

A tidal race, the Bore Rost, forms with the west going stream and an eddy forms on either side of the north part of Papa Westray.

BATHYMETRY AND SEABED

Off Mull Head, the seabed quickly drops to 30m before shelving out to 50m. The western side of Papa Westray forms a shallows between it and Westray itself – Papa Sound.

The BGS data indicates that the seabed offshore of Mull Head is a gravelly sand, but no data is recorded for the inshore area.

SHIPPING

Shipping traffic in this area is very light as the main shipping activity is held further offshore by the IMO adopted recommended route to the north of Orkney for tankers or hazardous cargoes.

Fishing vessel activity in through this area is also light.

FISHING

This area is thought to contain lobster, brown and velvet crabs and pot fishing activity. The eastern side of Papa Westray, into the North Sound, also supports common whelk and pot fishing.

Demersal and pelagic fishing may take place further offshore, but indicative fishing data shows little activity within this area.

MARICULTURE

There is no mariculture activity within this area.

ENVIRONMENTAL FEATURES

Papa Westray (North Hill and Holm) is designated as an **SPA** for the breeding colonies of Arctic skua and Arctic tern. In addition, this low-lying rocky coastline also contains other species such as storm petrel, fulmar, shag and a further 10 species of breeding bird. North Hill is also a **SSSI**.

There is a further SPA and SSSI to the west at West Westray with the Calf of Eday SPA to the south-east and the Faray and Holm of Faray SPA and SSSI to the south.

Marine mammals have been noted throughout the broader area of the northern Orkney Isles such as harbour porpoise, killer whales, Minke whales, pilot whales, pilot whale and white beaked dolphin.

Leatherback turtles have also been noted in the northern Orkney Islands.

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. There are no RYA recreational sailing routes passing through this area.

Land based tourism in the broader area of the northern isles is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include:

TIDAL AREA 8 – PAPA WESTRAY (MULL HEAD)

walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest.

CULTURAL HERITAGE

This small island is rich in archaeology and contains none Scheduled Ancient Monuments - including the Knap of Howar, the remains of the medieval chapel at St Tredwell's Loch and chambered cairns on the Papay Holm. It also has thirty listed buildings (category B and C) and a large variety of features noted in the National Monuments records of Scotland, including dykes, cairns, mills and old settlements.

There are no known wrecks within the potential resource area.

EXISTING INFRASTRUCTURE

There is no existing offshore infrastructure within the potential resource area.

PORTS AND HARBOURS

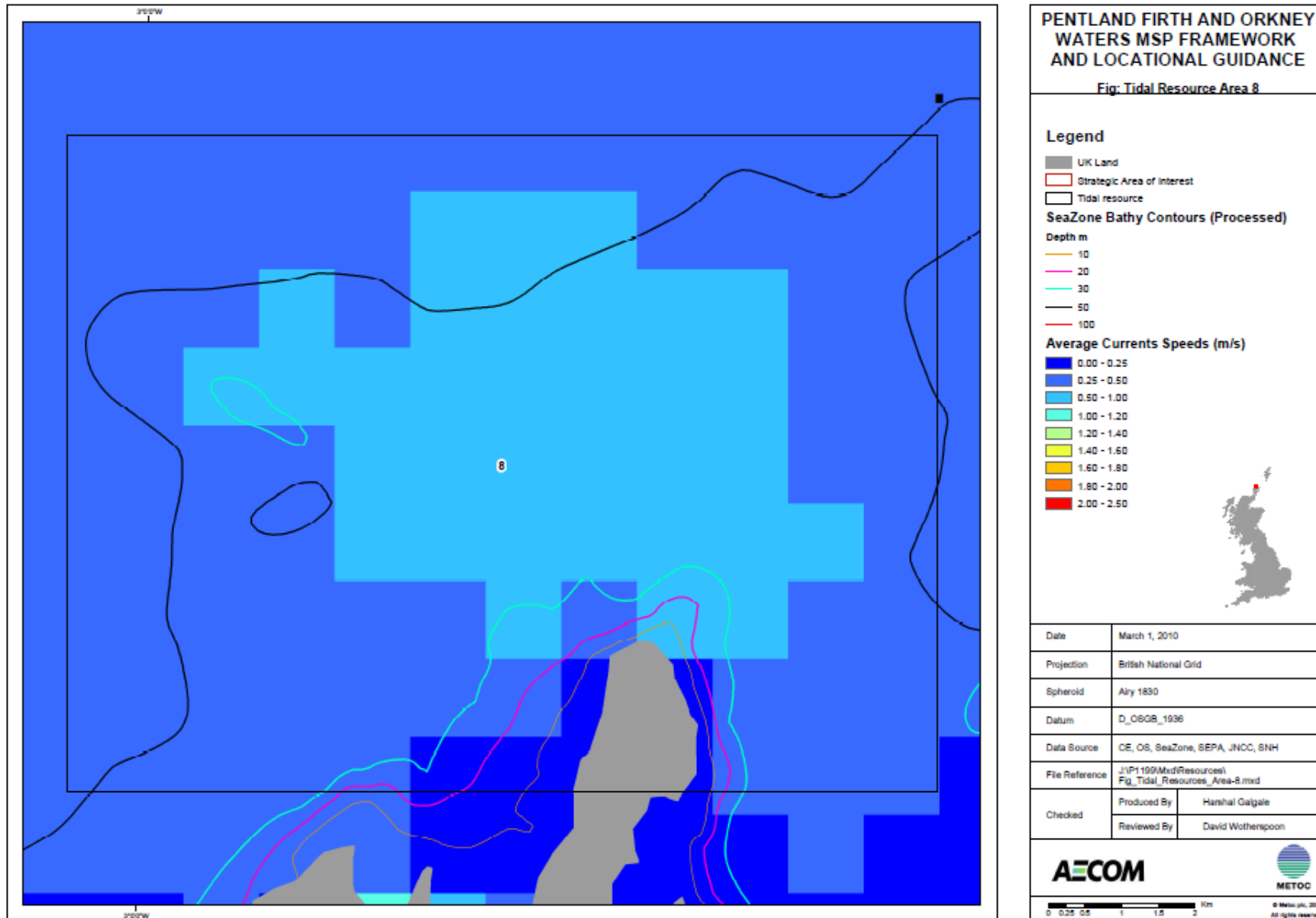
There are no large harbours in this area. Pierowall harbour lies close by on the east side of Westray, suitable for coasters. The closest large harbour is at Kirkwall, 20 miles to the south.

OTHER USERS

No other uses have been identified for this area.

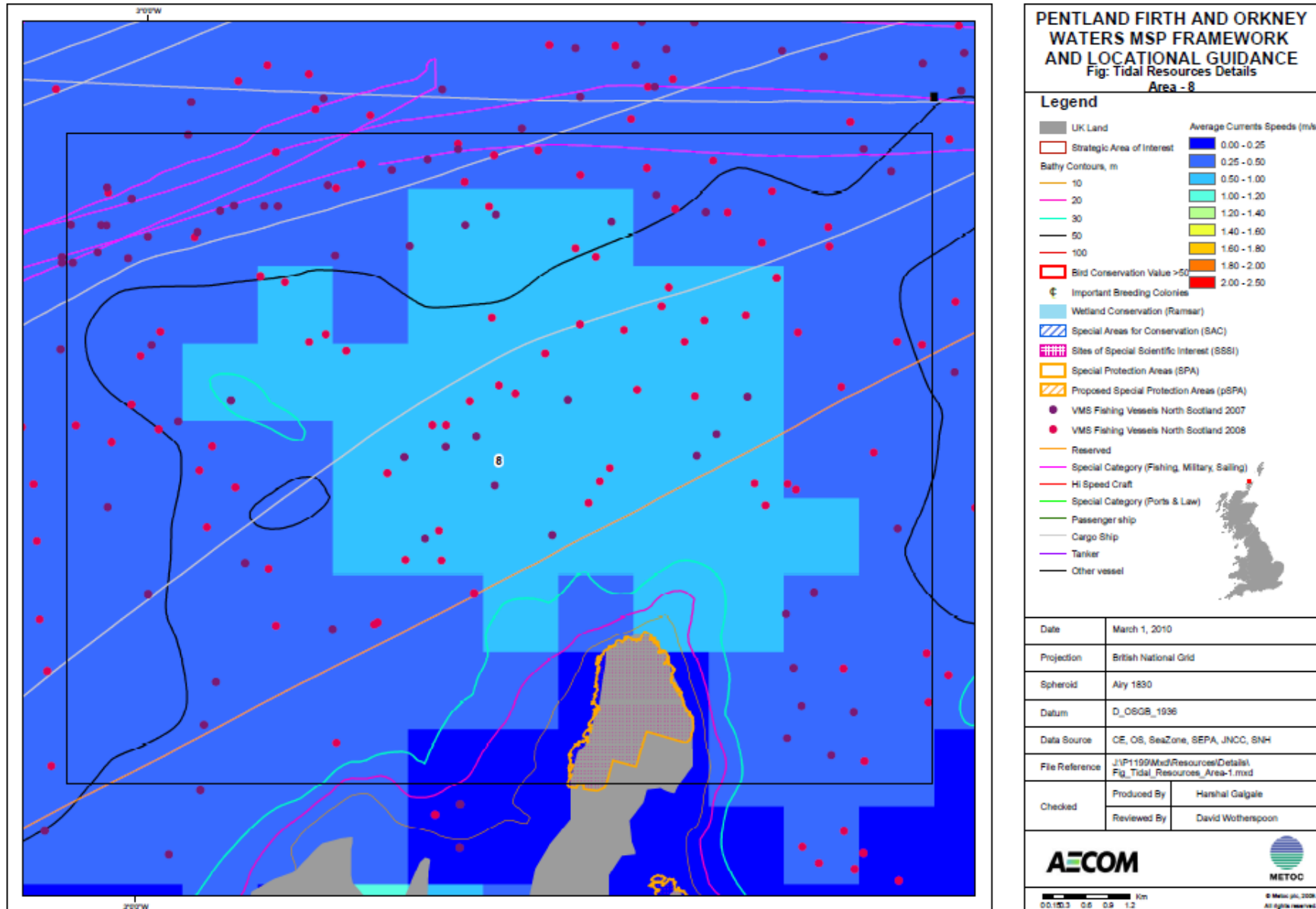
TIDAL AREA 8 – PAPA WESTRAY (MULL HEAD)

Figure 6.8a: Tidal Resource Area 8



TIDAL AREA 8 – PAPA WESTRAY (MULL HEAD)

Figure 6.8b: Tidal Resource Detail Map Area 8



TIDAL AREA 9 – SANDAY AND NORTH RONALDSAY

SUMMARY

The North Ronaldsay Firth is relatively shallow at 10 to 15m and unlikely to be of interest to present commercial tidal steam technologies. Little information exists on the strength of tidal currents in the area and the existing models are not sufficiently resolved or local reliant to be sufficiently accurate, and presently indicate that the resource is marginal for commercial scale development. However, there is sufficient weight of evidence to identify areas off some of the headlands to be of potential interest, subject to confirmation of the resource.

RESOURCE

At the north end of Sanday at Start Point, a tidal race forms with the south-east going stream in depths of 25 to 30m. A further race forms at the entrance to the North Ronaldsay Firth off Tofts Ness in 20m to 30m of water. At the north end of North Ronaldsay, a further race forms off Dennis Head, where the seabed quickly drops to 30m before shelving to 50m, where a spring stream of 2.5m/s is noted. The Admiralty Pilot also notes a spring rate of 3m/s off Seal Skerry.

BATHYMETRY AND SEABED

The North Ronaldsay Firth is relatively shallow at 10 to 15m. Off Dennis Head on North Ronaldsay, the rocky shore drops to 30m quickly before shelving to 50m.

The BGS data indicates that the seabed offshore to the north of North Ronaldsay is a gravelly sand, but no data is recorded for the inshore area.

SHIPPING

The north and east of North Ronaldsay are more heavily utilised by commercial shipping, marking a turning point for the IMO adopted recommended route to the north of Orkney for tankers or hazardous cargoes.

There is also a density of fishing vessel traffic following the same route as commercial shipping, but also operating close inshore off the east coast of North Ronaldsay and the north-east of Sanday.

Any tidal developments in this area would conflict with these inshore fishing operations and also the commercial shipping routes.

FISHING

This area is thought to contain lobster, brown and velvet crabs and pot fishing activity. Small areas of scallops are noted in the bays on the eastern side of North Ronaldsay and Sanday. Common whelk and pot fishing also takes place on the eastern side of Sanday.

Demersal and pelagic fishing may take place further offshore, but indicative fishing data shows little activity within this area.

MARICULTURE

There is no mariculture activity within this area, although Otterswick bay is a shellfish production area.

ENVIRONMENTAL FEATURES

There are no protected areas on North Ronaldsay itself, but immediately to the south on Sanday is the Sanday **SAC** and the East Sanday Coast **SPA, RAMSAR site**, and **SSSI**.

East Sanday Coast Ramsar site is a 40 km stretch of coast consisting of rocky and sandy sections and is notable for the presence of sand dune and machair habitats rare outside the Hebrides as well as extensive intertidal flats and saltmarsh.

The Ramsar site consists of parts of Northwall and Central Sanday SSSIs and the entire East Sanday Coast SSSI.

The East Sanday Coast SPA supports in winter, internationally important populations of the migratory species purple sandpiper and turnstone.

As well as its importance for the species mentioned above, the site is also of interest for its overall assemblage of wintering waders including, golden plover, oystercatcher, ringed plover, grey plover, lapwing, knot, sanderling, dunlin, snipe, bar-tailed godwit, curlew and redshank.

TIDAL AREA 9 – SANDAY AND NORTH RONALDSAY

As mentioned in other sections, the broader area of the northern Orkney isles is noted for the presence of harbour porpoise, killer whales, Minke whales, pilot whales, pilot whale and white beaked dolphin and Leatherback turtles have also been noted in the area.

RECREATION AND TOURISM

Marine and coastal recreational activities within the study area include: boat trips to view wildlife and landscapes, sailing, angling, scuba diving, windsurfing and sea kayaking. There is one RYA recreational sailing routes passing to the north of this area.

Land based tourism in the broader area of the northern isles is largely centred on historical and environmental attractions and is heavily dependent on those features that make the area unique, namely its bird life, coastal scenery and remoteness. Land based recreational activities and tourist attractions include: walking, cycling, bird watching shore-based cetacean watching and visiting historical sites of interest.

CULTURAL HERITAGE

This area, in common with much of Orkney, has a rich cultural heritage. North Ronaldsay possesses eleven Scheduled Ancient Monuments, more than thirty listed buildings and a host of features listed on the National Monuments Record of Scotland.

EXISTING INFRASTRUCTURE

There is no existing offshore infrastructure within the potential resource area.

PORTS AND HARBOURS

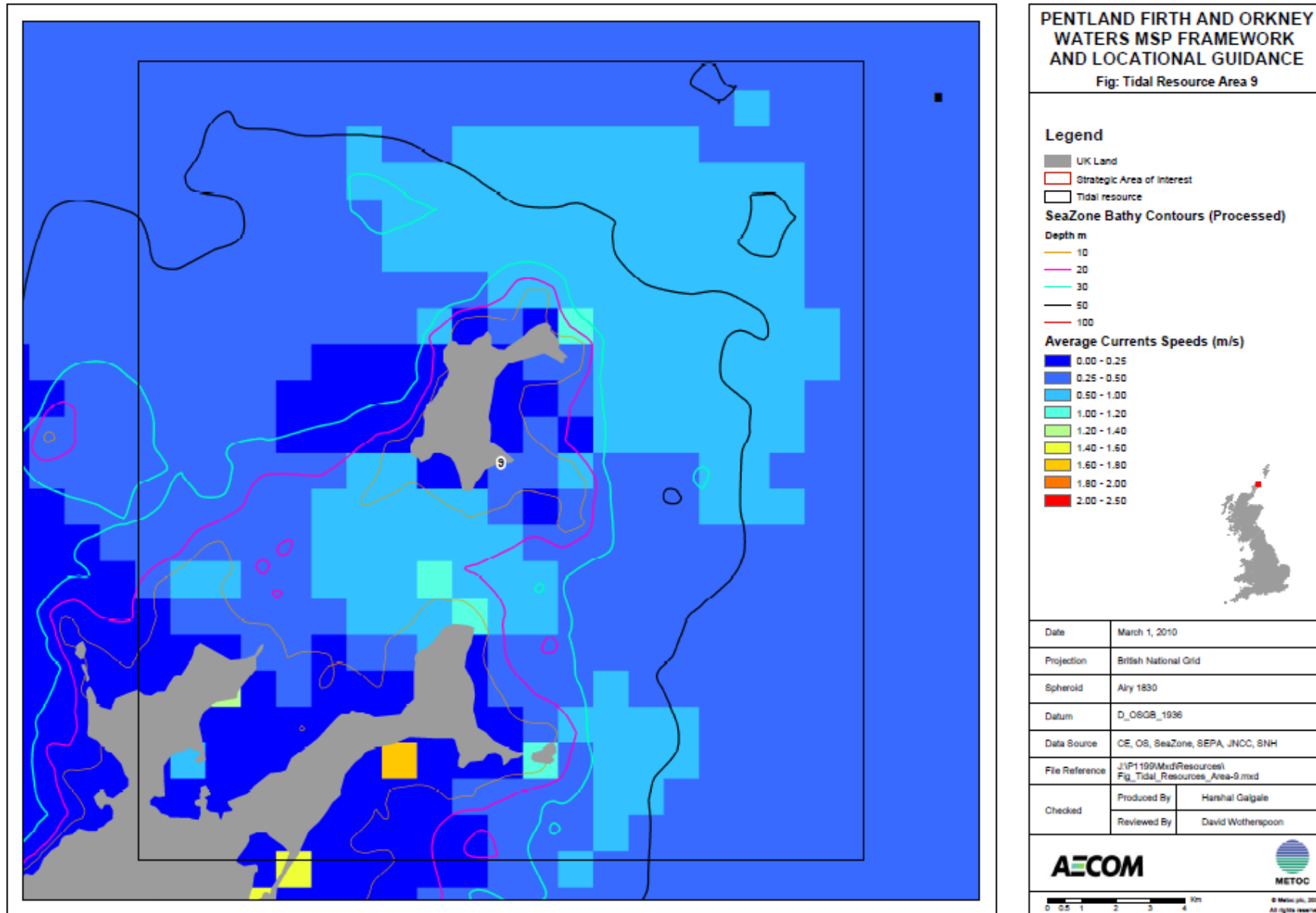
There are no large harbours in this area. The closest large harbour is at Kirkwall, 20 miles to the south.

OTHER USERS

No other uses have been identified for this area.

TIDAL AREA 9 – SANDAY AND NORTH RONALDSAY

Figure 6.9a: Tidal Resource Area 9



TIDAL AREA 9 – SANDAY AND NORTH RONALDSAY

Figure 6.9b: Tidal Resource Detail Map Area 9

