Inch Cape Offshore Wind Farm

New Energy for Scotland

Offshore Environmental Statement:

VOLUME 2A

Appendix 5B: Scottish Offshore Wind Farms - East Coast: Discussion Document (2) - Approach to Cumulative Effects Statement

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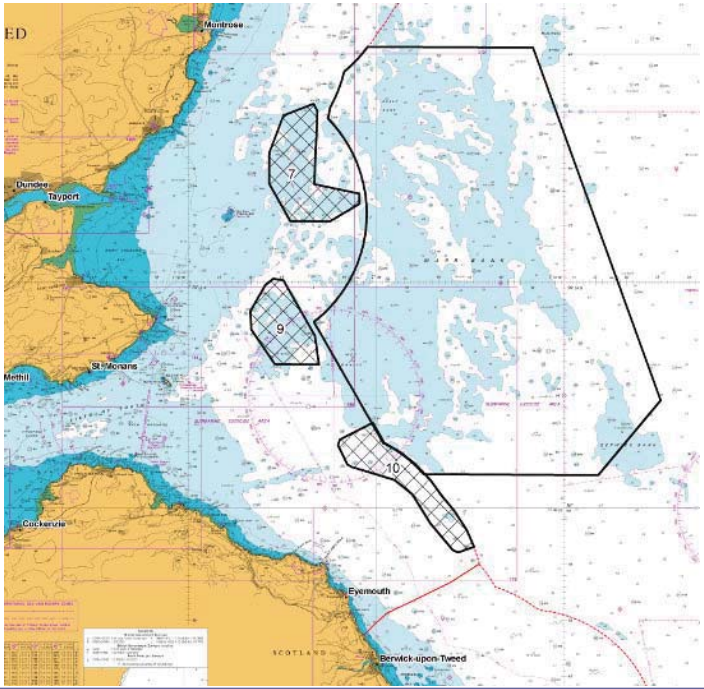

Scottish Offshore Wind Farms - East Coast

Discussion Document (2) – Approach to Cumulative Effects Assessment

Forth and Tay Offshore Wind Developers Group

November 2010
Final Report
9V9341

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thinking in
all dimensions

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EXECUTIVE SUMMARY

The Forth and Tay Offshore Wind Developers Group (FTOWDG) began collaborating in 2009 to identify potential cumulative effects on the environment of multiple wind farm development, and the potential effects of wind farm development in-combination with other current and reasonably foreseeable projects and activities. A desk-based study was commissioned, which identified those potentially significant cumulative effects requiring further assessment (see table below).

FTOWDG is now working with specialist consultants to develop assessment methodologies that will address those potential cumulative effects. The main aim of this task is to establish a common assessment benchmark, agreed with relevant stakeholders, which developers can carry forward during assessment of cumulative effects as part of individual project Environmental Impact Assessment (EIA).

This Discussion Document collates and presents the assessment methodologies that FTOWDG members propose to adopt, and encourages stakeholders to comment upon these.

Note to Reader: The FTOWDG welcome your thoughts on the proposals outlined in this Document. Questions are posed throughout the text and a consultee response template is provided at the end of the Document. We would be grateful if you could complete this and return it to us, as per the instructions given.

In some cases methodologies simply involve developers gathering and assessing environmental data in a standardised way within their EIAs. In other cases, novel approaches to regional assessment have been developed and will be taken forward collaboratively. The table below summarises the approach taken by FTOWDG members to addressing key cumulative effects. Where known, it details when assessments or surveys will be undertaken, and what outputs stakeholders can expect to be produced.

On the basis of feedback received from consultees, the FTOWDG will finalise methodologies and commence assessment tasks.

Receptor	Potential Cumulative Effects	Approach to Assessment
Designated Sites	• Effects on site conservation objectives and status	• Approach addressed in other relevant sections: see Benthic Ecology; Ornithology; Marine Mammals; Natural Fishery Resource.
Hydrodynamic Processes and Geomorphology	• Alteration of local hydrodynamic conditions (i.e. waves and tidal flows) • Changes to the sedimentary environment (e.g. suspended sediment concentrations, sediment transport pathways, patterns and rates, and sediment deposition) • Alteration of sedimentary seabed structures (e.g. sandbanks and other large scale bedforms) • Indirect effects of the above changes on other environmental receptors (e.g. benthos, fisheries)	• Regional STW metocean survey and separate Round 3 Zone metocean survey; survey methods consistent. • Regional STW numerical modelling exercise and Round 3 Zone to consider conceptual modelling approach; assessment outputs compatible. • Survey and modelling outputs to inform individual project EIAs.

Receptor	Potential Cumulative Effects	Approach to Assessment
Benthic Ecology	• Changes in hydrodynamic regime, sediment transport and geomorphology (such as scour effects or altered sediment deposition rates) leading to changes in habitats and communities • Direct loss of seabed habitat and changes in community structure • Changes in prey species • Introduction of new substrate (due to scour protection, mattressing, etc) and potential reef effects	• Standardised benthic survey methods agreed by FTOWDG members. • Consistent approach to assessment in individual project EIAs.
Ornithology	• Collision with turbines • Disturbance/displacement • Barrier effects • Indirect effects (e.g. changes in habitat or prey supply)	• FTOWDG Technical Report due quarter 2, 2011. • FTOWDG members sharing processed boat-based survey data in September 2011. • Common boat-based survey methods agreed by FTOWDG members. • Consistent approach to assessment within individual project EIAs on relevant topics (e.g. collision risk modelling).
Marine Mammals	• Disturbance or physiological effects as a result of underwater noise arising from construction, operational and maintenance activities associated with the wind farm development(s) • Potential longer term avoidance of the development area by marine mammals • Increased collision risk due to construction and maintenance traffic • Potential reduction of the feeding resource due to the effects of noise, vibration, and habitat disturbance on important prey species	• FTOWDG Technical Report due quarter 3, 2011. • Regional, collaborative approach to underwater noise modelling. • FTOWDG members sharing processed boat-based survey data in early 2011. • Consistent approach to assessment within individual project EIAs on relevant topics.
Natural Fishery Resources	• Disturbance as a result of elevated construction and operational sound levels • Barrier and displacement effects (noise and potential EMF) • Disruption of spawning and nursery grounds • Loss of habitat • Potential changes in food resource due to noise or habitat disturbance	• FTOWDG Technical Report. • Regional, collaborative approach to underwater noise modelling. • FTOWDG members sharing processed survey data (if survey required). • Consistent approach to assessment within individual project EIAs on relevant topics.

Receptor	Potential Cumulative Effects	Approach to Assessment
Shipping and Navigation	• Increased navigational risks: Grounding; Collision; Snagged fishing nets; Foundering; Contact • Operational effects on shipping: Diverting from routes; Increased fuel costs; Time costs	• FTOWDG members collaborating on baseline navigational survey (AIS survey, ongoing). • Regional navigational assessment due to commence early 2011. • Consistent approach to assessment within individual project EIAs on relevant topics.
Commercial Fisheries	• Complete loss or restricted access to traditional fishing grounds • Interference with fishing activities • Increased steaming times to fishing grounds • Sea bed obstacles (cables, foundations, etc) • Adverse impacts on commercially exploited fish and shellfish populations (see Natural Fishery Resources) • Impact on recreational fish populations • Safety issues for fishing vessels (see Shipping and Navigation)	• FTOWDG members collaborating on baseline fisheries survey (fishermen questionnaires, ongoing). • Consistent approach to assessment within individual project EIAs on relevant topics.
Seascape, Landscape and Visual Character	• Indirect effects on designated landscapes • Direct and indirect effects on undesignated seascapes • Indirect effects on undesignated landscapes	• FTOWDG members have agreed an approach to assessment (including an agreed list of assessment viewpoints). • Consistent approach to assessment within individual project EIAs on relevant topics.

CONTENTS

Acronyms and Abbreviations

AA	Appropriate Assessment
ADCP	Acoustic Doppler Current Profiler
AIS	Automatic Identification System
BAP	Biodiversity Action Plan
BGS	British Geological Survey
CCPA	Cumulative Close Point of Approach
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CEH	Centre for Ecology and Hydrology
COWRIE	Collaborative Offshore Wind Research Into The Environment
DASHH	Data Archive for Seabed Species and Habitats
DECC	Department for Energy and Climate Change
DTI	Department of Trade and Industry
DTM	Digital Terrain Model
EIA	Environmental Impact Assessment
ELIFONTS	Effects of Large-scale Industrial Fisheries on Non-Target Species
EPS	European Protected Species
FAME	Future of the Atlantic Marine Environment (FAME)
FCS	Favourable Conservation Status
FIR	Fishing Industry Representative
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
FSBI	Fisheries Society of the British Isles
FTOWDG	Forth and Tay Offshore Wind farm Developers Group
GIS	Geographic Information Systems
GPS	Geographic Positioning System
HRA	Habitats Regulations Assessment
ICES	International Council for the Exploration of the Sea
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IFG	Inshore Fishery Group
IMO	International Maritime Organisation
IMPRESS	Interactions between the Marine environment, PREdators and prey: implications for Sustainable Sandeel fish
JNCC	Joint Nature Conservation Committee
MAIB	Marine Accident Investigation Branch

MarLIN	Marine Life Information Network
MCA	Maritime and Coastguard Agency
MEDIN	Marine Environment Data Information Network
MESH	Mapping European Seabed Habitats
MFA	Marine Fisheries Agency
MGN	Marine Guidance Note
MMO	Marine Management Organisation
NBN	National Biodiversity Network
OREI	Offshore Renewable Energy Installation
OS	Ordnance Survey
PHA	Preliminary Hazard Assessment
PMF	Priority Marine Feature
PS	Permanent Threshold Shift
RADAR	RAdio Direction-finding And Ranging
RNLI	Royal National Lifeboat Institute
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency
SISP	Scottish Industry/ Science Partnership
SFF	Scottish Fishermen's Federation
SFO	Scottish Fishermen's Organisation
SMRU	Sea Mammal Research Unit
SNCA	Statutory Nature Conservation Agency (including SNH, Natural England and JNCC)
SNH	Scottish Natural Heritage
SOSS	Strategic Ornithology Support Services Group
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STW	Scottish Territorial Waters
SVIA	Seascape and Visual Impact Assessment
TTS	Temporary Threshold Shift
VMS	Vessel Monitoring System
WWT	Wildfowl and Wetlands Trust
ZTV	Zone of Theoretical Visibility

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1 INTRODUCTION

1.1 Background to Discussion Document (2)

In association with The Crown Estate, the developers of the three proposed Scottish Territorial Waters (STW) offshore wind farm sites off the Firths of Forth and Tay, and of the Firth of Forth Round 3 Zone in the North Sea (**Figure A**) have formed the Forth and Tay Offshore Wind Developers Group (FTOWDG). Anticipated developer timelines are shown below in **Table A**.

Table A Anticipated FTOWDG Developer Programmes *

Milestone	Forth Array **	Inch Cape (SeaEnergy Renewables)	Neart na Gaoithe (Mainstream Renewable Power)	Round 3 Zone 2, Phase 1 (Seagreen Wind Energy Ltd)	Round 3 Zone 2, Phase 2 (Seagreen Wind Energy Ltd)	Round 3 Zone 2, Phase3 (Seagreen Wind Energy Ltd)
Size (MW)	415	905	450	1000	1800	750
Area (km^2)	128.4	149.9	105.1	597	932	748
Scoping	Quarter 1, 2010	Q3, 2010	Q3, 2009	Q3, 2010	Q3, 2012	Q3, 2014
Environmental Impact Assessment	Q1, 2010 – Q3, 2012	Q3, 2010 – Q3, 2012	Q1, 2010 – Q4, 2011	Q4, 2009 – Q3, 2012	Q4, 2012 – Q2, 2014	Q4, 2014 – Q4, 2016
Planning Application submission	Q4, 2012	Q3, 2012	Q4, 2011	Q3, 2012	Q4, 2014	Q1, 2017
Planning decision	Q4, 2013	Q3, 2013	Q4, 2012	Q3, 2013	Q1, 2016	Q1, 2018
Construction commencement	2015	2015	2014	2015	2017	2019
Commissioning	2018	2019	2017	2017	2018	2020

* Note that the previously proposed 'Bell Rock' offshore wind farm site within Scottish Territorial Waters is no longer being progressed and therefore not considered in this document.

** As announced on 19th November 2010, Fred.Olsen Renewables will end its development activity at the Forth Array offshore project site in Scottish Territorial Waters. The Crown Estate is currently reviewing the status of this site.

The developers began collaborating in 2009 to identify potential cumulative[1] effects on the environment of multiple wind farm development, and the potential effects of wind farm development in-combination[2] with other current and reasonably foreseeable projects and activities associated with the following sectors:

- Other Wind Farms
- Commercial Fisheries
- Cables and Pipelines
- Oil and Gas Infrastructure

For the purposes of this Document, definitions are as follows:

[1] Cumulative – the effects of one type of development with other types of the same development (i.e. wind farms and other wind farms).

[2] In-combination - the effects of the above in combination with other, different projects and activities (e.g. wind farms in combination with dredging or wind farms in combination with shipping).

- Shipping and Navigation
- Waterfront and Coastal Development
- Airspace and Radar
- Military Activities
- Marine Aggregate Extraction
- Dredging and Sea Disposal
- Tourism and Recreation

A desk-based study was commissioned, which identified those potentially significant cumulative effects requiring further assessment. The findings of the study were reported in 'Scottish Territorial Waters Offshore Wind Farms – East Coast. Discussion Document – Cumulative Effects' (Royal Haskoning, Sept 2009). The document was issued to selected stakeholders for comment. This document can be found in **Appendix A**. The results of this consultation on the Document are summarised in **Appendix B**.

Based upon the findings of the first Discussion Document and the results of stakeholder consultation, FTOWDG is now working to develop assessment methodologies that will address the potential cumulative effects identified in **Table B** below.

Table B Potential Cumulative Effects

Receptor	Potential Cumulative Effects
Designated Sites	• Effects on site conservation objectives and status
Hydrodynamic Processes and Geomorphology	• Alteration of local hydrodynamic conditions (i.e. waves and tidal flows) • Changes to the sedimentary environment (e.g. suspended sediment concentrations, sediment transport pathways, patterns and rates, and sediment deposition) • Alteration of sedimentary seabed structures (e.g. sandbanks and other large scale bedforms) • Indirect effects of the above changes on other environmental receptors (e.g. benthos, fisheries)
Benthic Ecology	• Changes in hydrodynamic regime, sediment transport and geomorphology (such as scour effects or altered sediment deposition rates) leading to changes in habitats and communities • Direct loss of seabed habitat and changes in community structure • Changes in prey species • Introduction of new substrate (due to scour protection, mattressing, etc) and potential reef effects
Ornithology	• Collision with turbines • Disturbance/displacement • Barrier effects • Indirect effects (e.g. changes in habitat or prey supply)
Marine Mammals	• Disturbance or physiological effects as a result of underwater noise arising from construction, operational and maintenance activities associated with the wind farm development(s) • Potential longer term avoidance of the development area by marine mammals • Increased collision risk due to construction and maintenance traffic • Potential reduction of the feeding resource due to the effects of noise, vibration, and habitat disturbance on important prey species

Receptor	Potential Cumulative Effects
Natural Fishery Resources	• Disturbance as a result of elevated construction and operational sound levels • Barrier and displacement effects (noise and potential EMF) • Disruption of spawning and nursery grounds • Loss of habitat • Potential changes in food resource due to noise or habitat disturbance
Shipping and Navigation	• Increased navigational risks: Grounding; Collision; Snagged fishing nets; Foundering; Contact. • Operational effects on shipping: Diverting from routes; Increased fuel costs; Time costs
Commercial Fisheries	• Complete loss or restricted access to traditional fishing grounds • Interference with fishing activities • Increased steaming times to fishing grounds • Sea bed obstacles (cables, foundations, etc) • Adverse effects on commercially exploited fish and shellfish populations (see Natural Fishery Resources) • Impact on recreational fish populations • Safety issues for fishing vessels (see Shipping and Navigation)
Seascape, Landscape and Visual Character	• Indirect effects on designated landscapes • Direct and indirect effects on undesignated seascapes • Indirect effects on undesignated landscapes

Members of the FTOWDG have divided into 'topic' groups, each of which has been tasked with preparing assessment methodologies relevant to particular receptors. The groups have drawn on considerable in-house experience and expertise, appointed specialist consultants where appropriate and liaised with stakeholders in order to develop robust assessment methodologies that the group believes reflect current best practice. These methodologies are presented below in **Section 2**.

1.2 Offshore Wind Energy and Strategic Environmental Assessment

In the period between the issue of the first FTOWDG Discussion Document and this document, the Scottish Government has issued its Draft Plan for Offshore Wind Energy in Scottish Territorial Waters. The Draft Plan provides a strategic overview of where offshore wind farm development could and should not be progressed from a national perspective in the short (2010-2020), medium (2020-2030) and long (beyond 2030) term. Short term development encompasses the 10 areas for which The Crown Estate has granted exclusivity agreements, and which include the following sites: Forth Array; Inch Cape; and, Neart na Gaoithe.

The Scottish Government has subsequently issued its Strategic Environmental Assessment (SEA) of the Draft Plan. The SEA considers a range of in-combination and cumulative effects associated with the short and medium term options for offshore wind farm development. Potential effects are noted in relation to the following receptors:

- Water;
- Geology, sediments and coastal processes;
- Biodiversity, flora and fauna;
- Landscape, seascape and visual amenity;
- Population and human health; and

- Cultural heritage.

The SEA states that: 'There will be a need to manage the cumulative and in-combination impacts within STW and consequently it will be important to monitor other plans, programmes, activities and strategies throughout the duration of the Plan.'

In Scottish waters beyond 12 nautical miles, the UK Offshore Energy SEA, led by the Department for Energy and Climate Change (DECC), aims to help inform licensing and leasing decisions by considering the environmental implications of proposed plans/programmes, including Round 3 offshore wind farm leasing. Following consultation on the SEA, which is currently being updated, DECC released the following policy document in 2009: 'A Prevailing Wind: Advancing UK Offshore Wind Deployment' (DECC, 2009). This document recognises the need to assess potential cumulative effects associated with 'the increasing number of operational wind farms together, with those under construction, consented and in planning'.

The SEA identified potentially significant effects cumulative effects relating to the following issues:

- Underwater noise;
- Physical damage to features and biotopes;
- Physical presence;
- Marine discharges;
- Atmospheric emissions;
- Wastes to land; and
- Accidental events.

1.3 Document Objectives

The objectives of this second Discussion Document are as follows:

1. To continue to demonstrate to statutory and other key consultees the commitment of the FTOWDG to addressing potential cumulative effects early and effectively;

2. To present methodologies for the assessment of potential cumulative and in-combination effects;

3. To establish a common assessment platform, agreed with relevant stakeholders, which developers can carry forward during assessment of the environment effects as part of individual project Environmental Impact Assessment (EIA); and

4. To invite comment from statutory and other key consultees, and seek agreement on the methodologies developed by the FTOWDG.

This Discussion Document represents the next significant step, following issue of the first Discussion Document in 2009, in an iterative and non-statutory process which is focused on ensuring potential cumulative and in-combination effects are adequately considered in project EIAs undertaken by FTOWDG members.

This Document, whilst collated and edited by Royal Haskoning, represents the views of the FTOWDG members and their consultants, whom are acknowledged at the start of the Document and in the relevant sections of the Document.

1.4 Limitations of the Collaborative Approach to Assessment

The FTOWDG is committed to working collaboratively wherever practicable to address the potential cumulative effects associated with offshore wind farm development. However, it is important to understand that effective collaboration is more problematic in some areas due to different development timescales and this is elaborated upon below.

Project Definition

To inform the assessment of potential effects, a relatively detailed understanding of each of the proposed projects is required (e.g. number of wind turbines, turbine sizes, foundation types, installation methods and timing, etc). This information is necessary in order to understand how the developments will interact with the environment (e.g. its seabed footprint area, noise generated during installation, etc). Each of the FTOWDG members is committed to defining an appropriate Rochdale Envelope[3] that will be used to inform their EIAs, and have already broadly defined their projects in formal scoping documents, with the exception of phases 2 and 3 of the Round 3 Zone. In light of the differences between developer programmes, however, it is expected that FTOWDG members will not all be in a position to share detailed project information prior to submission of the first consent application by Mainstream Renewable Power in 2011.

Data Availability and Sharing

In principle the FTOWDG members are keen to share environmental data where this will inform cumulative effects assessment. However, it is important to understand that due to the differences in site development programmes, and hence the timing of surveys, data sharing will not always be appropriate. Despite this, FTOWDG members have sought to agree upon the use of standardised data collection methods wherever practicable, and where it is informative, have undertaken (or plan to undertake) collaborative desk-based studies using existing data.

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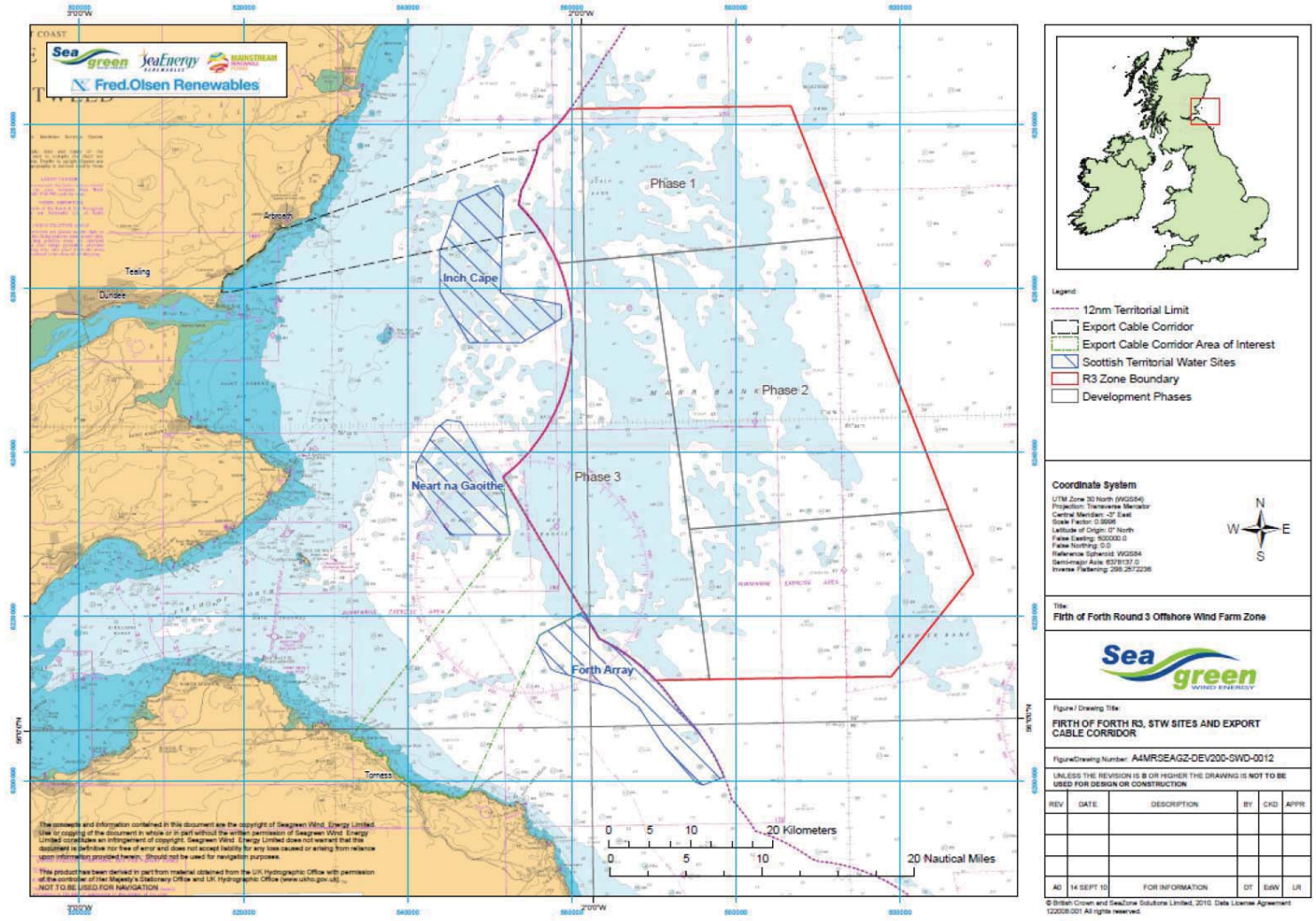
[3] Due to the uncertainties regarding the specific details of the projects, project information will be provided following the principles of the 'Rochdale Envelope'. This means that impact assessments will be carried out based on a realistic worst case scenario in terms of potential adverse or beneficial effects to the environment. Whichever scheme is ultimately built must have been covered by the scope of the EIA.

Figure A Proposed offshore wind farm sites.



2 ASSESSMENT OF EFFECTS

This section of the Document outlines the methods proposed to assess cumulative effects on a receptor-by-receptor basis. Note that assessment study areas vary and are appropriate to the receptor in question.

Method statements are at various stages of development. For example, some (including ornithology, marine mammals, seascape, landscape and visual character) have been discussed with regulatory bodies and data gathering has already commenced, whilst others have been more recently drafted and not yet discussed with external parties.

2.1 Nature Conservation Designated Sites

The development of multiple offshore wind farm sites (and associated power export infrastructure) has the potential to impact upon the integrity and conservation status of existing or candidate Natura 2000 sites. These sites include:

- Special Areas of Conservation (SACs) designated under the Habitats Directive (Council Directive 92/43/ EEC); and
- Special Protection Areas (SPAs) designated under the Wild Birds Directive (Council Directive 79/409/ EEC).

The UK is party to the International Convention on Wetlands (The Ramsar Convention) and many Natura 2000 sites are also designated as Ramsar sites.

Many of these sites also include areas designated as Sites of Special Scientific Interest (SSSIs) on the basis of their nature conservation significance at a national scale.

Potential effects on the protected features associated with these sites (i.e. species and habitats) are discussed under the relevant sections of this document:

- Effects on sub-tidal and intertidal habitats – see **Section 2.3**
- Effects on birds – see **Section 2.4**
- Effects on marine mammals – see **Section 2.5**
- Effects on migratory fish – see **Section 2.6**

SACs and SPAs considered relevant to the assessment of potential cumulative effects are listed in **Table C** below.

Table C Designated sites relevant to cumulative effects assessments

SACs	SPAs
Berwickshire and North Northumberland Coast	Buchan Ness to Collieston Coast*
Firth of Tay and Eden Estuary	Coquet Island
Moray Firth	Fala Flow
Dornoch Firth and Morrich More	Farne Islands
Isle of May	Firth of Forth AOS
River South Esk	Firth of Tay and Eden Estuary
River Tay	Firth of Tay and St Andrew's Bay AOS
	Forth Islands*
	Fowlsheugh

SACs	SPAs
	Gladhouse Reservoir
	Imperial Dock Lock, Leith
	Lindisfarne
	Loch Leven
	Loch of Skene
	Montrose Basin
	Muir of Dinnet
	Northumberland Coast
	Slamannan Plateau
	South Tayside Goose Roosts
	St Abbs to Fastcastle*
	Upper Solway Flats and Marshes
	Ythan Estuary, Sands of Forvie and Meikle Loch

NB * = recent marine extension added

2.2 Hydrodynamic Processes and Geomorphology

2.2.1 Potential Effects

Based on available literature, the following are perceived to be the main potential effects on hydrodynamic processes as a result of wind farms within the marine environment (Cefas, 2004):

- Alteration of local hydrodynamic conditions (i.e. waves and tidal flows);
- Changes to the sedimentary environment (e.g. suspended sediment concentrations, sediment transport pathways, patterns and rates, and sediment deposition);
- Alteration of sedimentary seabed structures (e.g. sandbanks and other large scale bedforms);
- Indirect effects of the above changes on other environmental receptors (e.g. benthos, fisheries).

2.2.2 Study Area

The study area encompasses all STW sites and the Round 3 Zone, including adjacent and nearshore waters.

The near-field (local) and far-field (regional) study area extents for STW and Round 3 sites will be agreed with the regulator. Study area extents will need to be of sufficient detail to adequately inform potential effects and cumulative assessment.

Question 1

Is the proposed Study Area appropriate? (If not, what alternative would you propose?).

2.2.3 Data Gathering

Desk-based Review

The developers of the STW sites commissioned HR Wallingford to undertake a desk-based review of existing metocean information, which:

- Assessed the suitability of existing datasets as inputs to a regional metocean modelling exercise;
- Prepared preliminary engineering design criteria based on current datasets; and
- Designed a survey methodology and programme to further characterise metocean conditions across the STW sites.

Findings are presented in a Technical Note (HR Wallingford, 2009) that is shown in **Appendix C**. The Round 3 Zone was not considered in this review, though numerous British Oceanographic Data Centre (BODC) pressure and current meter records exist within, and in close proximity to, the Round 3 Zone. The note concluded that there is already sufficient data to characterise the broad scale coastal regime of the Forth and Tay estuaries, and that the main data gap is represented by the need for greater and more detailed characterisation of site-specific conditions within the wind farm sites.

Metocean Survey

To provide further information for characterisation of site-specific conditions within individual sites and to inform site development and support the EIA process, the STW members of FTOWDG undertook a metocean survey over winter 2009/2010 (**Table D**) to fully characterise conditions across their sites and the wider study area. The survey gathered the following data:

- Measured at every location by Wave Rider and ADCP
  - Current Speed and direction at near surface and near seabed
  - Directional wave spectra such as wave height, period and directionality
- Background meteorological conditions (Wind speed and direction measured by MetBuoy

Table D STW metocean survey buoy deployment.

Site	Equipment	Lat	Lon	Deployment Date	Recovered
Inch Cape	Waverider & ADCP	56 27.539'N	-2 11.422'W	10/12/2009	June 2010
Neart na Gaoithe	Waverider & ADCP	56 15.724'N	-2 14.298'W	10/12/2009	Sept 2010
Forth Array	Waverider & ADCP	56 03.433'N	-1 54.964'W	08/12/2009	June 2010
(North) Offshore	Waverider & ADCP	56 44.342'N	-1 49.948'W	10/12/2009	June 2010
Met Buoy	Met Buoy	56 15.718'N	-2 14.043'W	10/12/2009	June 2010

Survey work is planned to commence shortly in the Firth of Forth Round 3 Zone. **Table E** below shows the location and parameters which will be measured.

Table E Round 3 Firth of Forth Zone metocean survey buoy deployment.

Firth of Forth Round 3 Zone	Equipment	Lat	Lon	Deployment Date	Recovery Date

Firth of Forth Round 3 Zone	Equipment	Lat	Lon	Deployment Date	Recovery Date
A	Wave, Current	56° 39.09'	-01° 59.09'	Nov 2010	April 2011
B	Current	56° 39.56'	-01° 36.33'	Nov 2010	April 2011
C	Wave, Current	56° 15.29'	-01° 21.99'	Nov 2010	April 2011
D	Current	56° 20.06'	-01° 46.26'	Nov 2010	April 2011
E	Wave, Current	56° 31.69'	-02° 34.16'	Nov 2010	April 2011
F	Wave, Current	55° 58.33'	-02° 21.31'	Nov 2010	April 2011
G	Current	56° 16.13'	-02° 07.34'	Nov 2010	April 2011
H	Wave, Current	56° 05.72'	-01° 54.58'	Nov 2010	April 2011

Question 2

Are you aware of any additional data sources that should be considered in the assessment?

2.2.4 Data Analysis

Regional Modelling

FTOWDG members are committed to undertaking modelling of metocean conditions and coastal processes to inform project development, EIAs, and to understand potential cumulative effects. The data gathered during desk-based reviews and metocean surveys would be used to calibrate the model.

Recommendation: The STW developers will share metocean survey data amongst the group and collaborate in a numerical modelling exercise at a regional scale in order to determine any cumulative effects. The model would take account of:

- Baseline scenarios (tides, waves and sediments);
- Wind farm scenarios (investigation of near and far-field effects on each proposed wind farm in isolation); and
- Cumulative effects (extra to the isolated wind farm scenarios).

Due to the timing of surveys and development schedules, the Round 3 Zone will undertake a separate data collection (metocean) and assessment exercise to determine cumulative effects, the exact approach and timing of which is to be agreed with Marine Scotland. Therefore, at this stage it is not possible to state that the approach will be similar to that used by STW developers. However, the Round 3 Zone approach will utilise regionally acquired metocean data to enable cross-referencing between FTOWDG model and Round 3 Zone assessment outputs.

Table F Summary of hydrodynamic processes and geomorphology methods and activities agreed between developers.

Method/Activity	Status
Desk based review of existing information	Combined exercise by STW developers, yet to be completed for Round 3 Zone – information to be shared amongst group
Metocean survey	Combined survey by STW developers, yet to be completed for Round 3 Zone

Regional modelling and coastal processes assessment	To be undertaken separately by STW developers and Round 3 Zone developers

Question 3

Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).

2.2.5 Presentation of Results

Each of the STW developers will receive a copy of the metocean model which can be used to run a variety of scenarios such as what the sediment transport in the area would be without wind farms and what potential effects wind farms could have on sediment transport. This will be undertaken by individual STW developers for each EIA. The Round 3 Zone developer will utilise an assessment approach that will be agreed with Marine Scotland, which will cross-reference the STW model, to produce compatible assessment outputs.

2.3 Benthic Ecology

2.3.1 Potential Effects

The potential direct and indirect effects of the development of multiple offshore wind farms on benthic ecology may include:

- Changes in hydrodynamic regime, sediment transport and geomorphology (such as scour effects or altered sediment deposition rates) leading to changes in habitats and communities;
- Direct loss of seabed habitat and changes in community structure;
- Changes in prey species associated with the above; and
- Introduction of new substrate (due to scour protection, mattressing, etc) and potential reef effects.

Potential effects may be felt locally within the works footprint of each wind farm site and/or across a wider surrounding area. However, based on the findings of studies for existing offshore wind farms, it is anticipated that any changes to benthic ecology will be largely limited to near field effects, within and close to the development footprint for each wind farm.

2.3.2 Study Area

The primary study area is made up of each wind farm site and its associated cable route corridor. New benthic data will be collected within this study area as part of EIA works undertaken by each FTOWDG member.

It may be necessary for effects to be considered in a wider context; in particular consideration of benthic ecology of the North Sea and wider UK and European waters may be appropriate when considering potential effects on some species and habitats. The extent of this wider contextual study area will only be determined following receipt of survey results.

Question 4

Is the proposed approach to Study Area appropriate? (If not, what alternative would you propose?).

2.3.3 Data Gathering

The focus of data collection will be the characterisation of benthic ecology within each wind farm site and its cable route corridor, based on a review of geophysical survey data, new benthic survey data, and existing (past) survey data.

It is intended that individual developers undertake data gathering on a site specific basis, with the approach to collection and analysis standardised across all FTOWDG members, enabling data sharing and application of a common framework to the assessment of effects on benthic ecology within project EIAs.

Data Collection – Phase 1

A desk-based data collation exercise will gather information from a range of sources, including those listed below, to allow provisional characterisation of the benthic ecology features of the wind farm sites and export cable corridors and, where possible estimate the relative abundance and distribution of biotopes across the study area. This will include provisional identification of potential Annex 1 habitats listed on the European Habitats Directive, any UK Biodiversity Action Plan (BAP) habitats and species, and any Scottish Priority Marine Features (PMFs).

Data sources are likely to include:

- British Geological Society (BGS) – seabed sediment maps;
- Survey and research data held by Marine Scotland Science, other regulatory bodies (Scottish Natural Heritage; Joint Nature Conservation Committee; Centre for Environment, Fisheries and Aquaculture Science), and universities (University of Aberdeen; University of St Andrews);
- Mapping European Seabed Habitats (MESH);
- Strategic Environmental Assessments (DECC Region 5 SEA and UK Offshore Energy SEA, and Scottish Government Offshore Wind Energy in Scottish Territorial Waters SEA);
- National Biodiversity Network (NBN);
- Marine Environment Data Information Network (MEDIN);
- Marine Life Information Network (MarLIN);
- Data Archive for Seabed Species and Habitats (DASHH);
- OSPAR Convention for the protection of the marine environment of the north-east Atlantic.

Data Collection – Phase 2

Data collection strategy and survey planning will be informed by the results of geophysical seabed surveys undertaken by the FTOWDG members.

Marine ecological surveys will be (or have been) undertaken across each of the FTOWDG wind farm sites and associated cable route corridors by individual developers as part of their site-specific EIA works. The FTOWDG will adopt standardised protocols for the collection, processing, quality assurance and dissemination of marine biological data (see **Appendix D**). A

survey specification has been agreed by FTOWDG members and methodologies will also be agreed with Marine Scotland in consultation with Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee (JNCC). This approach will result in standardised datasets that can be shared between developers and readily compared.

It is anticipated that the survey methods outlined in **Table G** will form (or have formed) the basis for all benthic surveys by the FTOWDG, with detailed survey locations and sample numbers determined on a site-by-site basis, informed by geophysical survey data.

Table G Ecological Survey Requirements

Survey Requirement	Implementation
Grab	• Grabs will acquire quantitative information on seabed sediments and associated benthic fauna at a number of stations across each survey area.
Drop down video or stills camera	• Drop down video or stills will be used to identify habitats and features of interest such as hard seabed areas, allowing epifaunal communities to be described.
Intertidal biotope mapping	• Biotopes will be mapped in the intertidal zone where export cables will meet the shore, with cores collected for infaunal analysis where appropriate.
Epibenthic beam trawl	• A trawling programme using a scientific beam or alternative trawl will be undertaken to assess the benthic sessile and mobile epibenthic megafaunal communities.

Survey findings will support and refine the outputs of the desk-based study, enabling the seabed environment across all of the FTOWDG areas to be characterised and results fed into the cumulative effects assessment within each site's Environmental Statement.

Key uses of the data collected include:

- Determine the physical nature of the seabed sediments including contaminants;
- Define / ground truth seabed habitats present and their distribution;
- Determine both the benthic and epibenthic fauna associated with the seabed habitats and enable biotope definition;
- Identify any Annex I habitats or other priority features; and
- In combination with the results of geophysical survey, produce ground truthed mapping of predictive distribution of biotopes across each FTOWDG site.

Question 5

Are you aware of any additional data sources that should be considered in the assessment?

2.3.4 Data Analysis

Biotope and Habitat Maps

Each developer will produce biotope and seabed type / habitat maps for their individual sites using data gathered from geophysical survey, in combination with data from benthic surveys (using benthic grabs, trawls and video) as ground truthing.

Biotopes will be defined using 'The Marine Habitat Classification for Britain & Ireland, v 04.05' (Connor *et al*, 2004). Maps will be produced using Geographic Information Systems (GIS) in an agreed format.

Recommendation: It is proposed that the FTOWDG individual developers undertake a collaborative structured exercise at this point to:

- Share biotope/habitat maps and allow consideration of areas outside the sites and their associated cable route corridors, 'filling in gaps' between sites. This would be done using publicly available information discussed previously in this paper;
- Identify those biotopes which are widely distributed and 'common' in the context of the FTOWDG sites and wider study area and allow the focus of assessment to be brought to bear on 'uncommon' biotopes and species; and
- Where biotopes or species are uncommon, potential for cumulative effects in relation to marine benthos will be considered using an agreed approach and using mapping data to gauge the extent and distribution of that biotope across the FTOWDG sites. Those 'uncommon' biotopes and species that do not occur in more than one wind farm site to be removed from further cumulative effects analysis, but will of course be considered and assessed at a site specific level.

It is important to note that the survey programmes in place for each of the FTOWDG sites vary considerably. For those developers further ahead in the process, the availability of data from the sites being surveyed by other FTOWDG members may be limited and consequentially, the approach to consideration of cumulative effects will be precautionary and based on existing data.

Project Details

To support assessment of cumulative effects, all developers will share the following project information at the earliest opportunity:

- The area of seabed which may be covered by turbine foundations and substations (m^2)
- The area of seabed potentially disturbed through cable laying, anchor laying and barge operation (m^2);
- The anticipated burial depth, route and area of potential seabed disturbance along the cable corridor;
- The area of substructures which will potentially available for colonisation by epifauna (m^2); and
- Proposed installation programme.

Assessing the potential effects of direct habitat loss

Recommendation: Using the derived infrastructure footprint parameter, the potential effects through direct habitat loss will be assessed via quantifying any losses in terms of % loss of certain biotopes/habitats.

In addition, for areas where infrastructure is buried, the % temporary loss of habitat will also be quantified. Where available, data gathered from other wind farms and relevant marine industries will be used to determine whether there may be more long-term modification.

Assessing the potential for habitat change from hydrodynamic and sediment transport changes

Recommendation: Using the understanding gained from sediment process modelling (conceptual or numerical modelling may be used) the area potentially affected by changes to sediment processes will be quantified and mapped using the GIS and the potential impact assessed. It is important to note that at existing offshore wind farms, modelling and post construction survey of the foundations and surrounding areas have shown that all effects are likely to occur in the near field.

Assessing the potential impact of colonisation

Recommendation: Evidence from past studies of bio fouling of marine structures, will be used to determine the potential for colonisation of the infrastructure. The probability and sensitivity of the natural biotopes within an appropriate study area, to invasion of species associated with the bio fouling communities, will be assessed.

Approach, methods and activities agreed by FTOWDG to inform assessment of benthic ecology are summarised in **Table H**, below.

Table H Summary of benthic ecology methods and activities agreed between developers.

Method/Activity	Status
Desk based review of existing information	Collaborative / joint review
Benthic survey	Data to be shared amongst group, collected using the standardised data collection methods detailed in this paper
Biotope and habitat mapping	Initially undertaken by individual developers, followed by collaborative mapping exercise
Assessing the potential effects of direct habitat loss	Developers to share project details to inform assessment
Assessing the potential for habitat change from hydrodynamic and sediment transport changes	Developers to share conclusions of sediment process modelling to inform assessment
Assessing the potential impact of colonisation	Developers to share project details to inform assessment

Question 6

Are the proposed methods suitable? (If not, what alternative would you suggest?).

2.3.5 Presentation of Results

Cumulative effects will be considered within the relevant chapters of the Environmental Statements produced for each development, using standardised impact assessment criteria which will be agreed by FTOWDG members and Marine Scotland, in consultation with SNH and the JNCC.

It is intended that the sensitivity of key species (i.e. predominant faunal group or Annex I species – if present) and the potential impact upon them, will be assessed using the MarLIN sensitivity rationale (http://www.marlin.ac.uk/sensitivityrationale.php). It is assumed that the sensitivity of these species will be indicative of the responses of other species within the same family/group.

2.4 Ornithology

The 'Scottish Territorial Waters Offshore Wind Farms – East Coast. Discussion Document – Cumulative Effects' (Royal Haskoning, Sept 2009) identified the potential for cumulative effects on birds and recommended that cumulative assessment should 'adhere to the approach detailed in recently published (COWRIE) guidance (King *et al*, 2009)'. The following recommendations are therefore taken directly from the COWRIE guidance with minor amendments to make them specific to the FTOWDG projects.

This guidance recommends that 'key features' tables are used at an early stage to identify the sensitive bird receptors that may be at risk. These tables have been compiled and the results reported to SNH and RSPB at meetings on 27th and 23rd October 2009 respectively. Amendments proposed by SNH (letter of 11th December 2009) and RSPB (letter of 29th January 2010) have been incorporated into a revised report which was circulated in August 2010 (Amec 2010).

2.4.1 Potential Effects

The potential effects of offshore wind farms on birds are usually summarised as:

- Collision with turbines;
- Disturbance/displacement;
- Barrier effects; and
- Indirect effects (e.g. changes in habitat or prey supply).

These effects may operate at individual offshore wind farm sites, cumulatively between a number of offshore and possibly onshore wind projects or in-combination with other non-wind farm activities (e.g. aggregate dredging).

2.4.2 Study Area

The cumulative study area will initially cover waters from Peterhead in the north to the Farne Islands off Northumberland in the south to take account of bird migration and general species mobility. This region may need to be extended for certain species (e.g. migratory species or those with a large foraging range) and may also include onshore areas where appropriate.

The COWRIE guidance recommends that wind farm projects to be incorporated in cumulative assessment should include:

- Consented projects which are yet to be constructed;
- Projects for which application has been made;
- Projects which are reasonably foreseeable (i.e. for which data are available); and
- Existing projects (e.g. onshore projects which have yet to exert a predicted effect [i.e. an effect not covered in the baseline])

'Reasonably foreseeable' projects to be taken into account have been identified (Royal Haskoning, 2009) as:

- Offshore wind farm projects, specifically those within the Firth of Forth and Tay including all those in the adjacent Round 3 Zone 2 Firth of Forth;
- Offshore wind farm projects in Moray Firth and off Aberdeen; and
- Offshore wind farms further south.

Specifically, these include:

- Inch Cape;
- Neart na Gaoithe;
- Forth Array;
- Firth of Forth Round 3 zone (all projects);
- Beatrice STW site;
- Beatrice Demonstrator;
- Moray Firth Round 3;
- Aberdeen Offshore Wind Farm Demonstration Site;
- Methil Offshore Wind Farm Demonstration Site
- Blyth Offshore Wind Farm and
- Blyth Offshore Wind Farm Demonstration Site.

It should be noted that Bell Rock and the 'medium term' options outlined in Marine Scotland's current Strategic Environmental Assessment (SEA) of the Draft Plan for Offshore Wind Energy in Scottish Territorial Waters have been scoped out of this assessment as these are not considered to be 'reasonably foreseeable' i.e. no data is likely to be available.

For particular wide-ranging species such as gannet, or migratory species such as geese, where the effects of other wind farms, including onshore developments and other Round 3 zones, may need to be taken into account additional siteswill be considered on a case by case basis.

Advice will be sought from the Statutory Nature Conservation Agencies (SNCAs) regarding the identification of any major onshore projects which are constructed 'but have yet to exert a predicted effect'.

Collision and barrier effects are fairly specific to wind farms, therefore no non-wind farm projects will be considered in the cumulative assessment of these effects.

In relation to disturbance and displacement, there could be potential for cumulative effects with shipping and fishing or other marine renewables projects (e.g. wave and tidal) although this has yet to be demonstrated. FTOWDG will therefore keep specific non-wind farm activities in the region under review and consider them in relation to particular species on a case by case basis.

Similarly, in relation to indirect effects on habitat and prey species, particularly during construction, there is potential for cumulative effects with non-wind farm activities such as aggregate dredging and commercial fishing. However, information on how these effects accumulate is limited. This situation will also be kept under review and advice sought from the SNCAs. These effects will also be considered in relation to the impact assessment of natural fisheries.

2.4.3 Data Gathering

In most cases, data collected for environmental impact assessment will form the basis of cumulative impact assessment and additional data gathering will not be required. As a minimum, this will comprise:

- Boat-based survey data collected once per month over a two year period; and
- Aerial survey data.

The Crown Estate enabling actions have already ensured that aerial bird survey data are collected in a consistent manner across the Firth of Forth Round 3 zone, the adjacent Scottish Territorial Waters sites in the outer Forth, the Moray Firth Round 3 zone and the Beatrice site. The methodology used in this instance is aerial visual sampling and the surveys were carried out by WWT over a full year beginning in May 2009 and finishing March 2010. All members of the FTOWDG group have been given access to the full data set.

All FTOWDG developers are following a compatible methodology for boat-based surveys based on European Seabirds At Sea methods as modified for offshore wind farms by e.g. Camphuysen *et al*. 2004, Maclean *et al*. 2009. Data recording will utilise modified European Seabirds at Sea categories and a standard spreadsheet has been circulated within the FTOWDG group. Developers are currently agreeing the means by which the sharing of processed data can be facilitated in order to carry out cumulative impact assessment.

Question 7

Are you aware of any additional data sources that should be considered in the assessment?

2.4.4 Data Analysis

For each effect, recommendations for data analysis are summarised in the blue boxes below. This information is based on King *et al.* (2009) and further details of the assessment requirement are provided in the text which follows.

The significance of each impact will normally be assessed according to the number of birds affected as a proportion of the relevant population and taking account of the species' conservation status.

Population estimates for SPA species will be taken from the Natura 2000 standard data form and also from any more recent data in the SPA review. Advice will be sought from SNH and JNCC on how to utilise this data in relation to species which have undergone population changes since designation. It is accepted that the process of assigning birds to SPA populations across the study region is likely to be complex owing to the number of SPAs with the same qualifying and assemblage species.

Advice will also be sought from SNCAs on how to determine the local and regional population size for non-SPA species. For these species, it may be possible, using population modelling, for thresholds of impact to be agreed with SNCAs. For SPA species, this may not be possible and this is discussed further in **Section 2.4.5**.

Collision

Recommendation: Cumulative collision risk should be calculated by summing collision numbers from each individual wind farm. The total number should then be presented as a percentage of the relevant population or populations (e.g. local, regional, national) and also as a percentage change in background mortality rate. Where effects are expected to be significant, they should be discussed in the context of the life history of the species. In some cases a population modelling approach may be required.

In order that collision data are comparable, methods of collision calculation should be transparent. To facilitate this, developers should provide the following data for each species, broken down by survey trip or season:

- Bird numbers;
- Density/passage rates;
- Population estimates for the wind farm site;
- A clear description of how the above values are derived;
- A spreadsheet showing each stage of the collision risk calculations.

Offshore developers usually use a variation of the SNH's Band Model (http://www.snh.gov.uk/strategy/renewable/sr-we00a1.asp) to calculate collision risk. However, this was developed for onshore species. The Forth and Tay Offshore Wind Developers' Group is currently discussing the process of collision risk calculation for offshore species and The Crown Estate's Strategic Ornithological Support Services (SOSS) group is likely to support a similar research project. The SOSS project will review information on generic flight heights for key species; avoidance rates; guidance documents in general, plus a review of available collision risk models. SNH has also recently produced new guidance on avoidance rates (SNH 2010). FTOWDG developers will take this into account together with any new advice arising from the SOSS projects

Disturbance and Displacement

Recommendation: Where disturbance/displacement is expected to be minimal, subjective/qualitative treatment is adequate. This will be assessed by summing the number of individuals of a species which may be disturbed or displaced in relation to the relevant population (e.g. local, regional, national) and discussed in the context of the species conservation status. Areas should be assumed to be at carrying capacity and the default assumption is that all birds that are displaced die. Any difference in assumptions should be explained in the Environmental Statement. Where disturbance effects are expected to be significant, a quantitative treatment including energetics studies may be appropriate. The need for quantitative studies should be agreed using expert judgment and in discussions with SNCAs at an early stage.

FTOWDG will need to agree with SNCAs which species are susceptible to disturbance and displacement based on existing information sources e.g. Garthe and Huppop 2004, Langston 2010 (see **Table J**). Agreement will also be needed on the level e.g. a percentage of the population, at which the impact is deemed to become significant.

The biological significance of disturbance effects may vary according to the species use of an area. It will therefore be important that FTOWDG ornithological surveyors collect as much

behavioural data as possible during bird surveys so that usage can be discussed and, where possible, assigned.

A SOSS research project has been proposed to assess the evidence of levels of displacement caused by wind farms during and post construction and to provide guidance to developers as to how displacement estimates should be interpreted. However, this project may not report in time to be useful for all FTOWDG projects.

Barrier Effects

Recommendation: Current thinking is that barrier effects for migrating species do not present the problem that was initially anticipated, with many species taking far-field avoidance of wind farms with minimal effects on energy budgets (Speakman *et al* 2009). In this instance, qualitative treatment is sufficient. Where effects are expected to be significant (e.g. for avoidance of multiple wind farms on a migration route or repeated daily avoidance where the wind farm(s) lie between feeding and roosting grounds) quantitative treatment on energy demands may be appropriate (e.g. Masden *et al* 2009) and should be species specific (Masden *et al* 2010).

Migratory species specific to the region have been identified in the Revised Cumulative Study Report - Ornithology (AMEC, 2010) and will also be identified via normal EIA practice.

The group has also considered a WWT proposal for the satellite tracking of migrant geese in relation to the FTOWDG wind farms. However, the proposal is not thought to represent value for money and is not being progressed at this point in time. Other ways of collecting additional data are currently being explored and could include, for example, the collation of data on generic flight height of migrants, the possible use of MOD radar data, the use of modified boat-based survey methods to provide 'flux' counts (Vanermen and Stienen, 2009) and modelling to estimate the number of birds on passage through the wind farm area. The issue, in general, is industry-wide and it has therefore been proposed as a potentially suitable study area for SOSS group. This work is likely to include a review of literature on migration routes, heights, weather conditions etc for key species potentially affected by offshore wind farms.

Question 8

With cost in mind, is there any one particular migratory species for which additional data is considered essential? If so, which species?

Indirect Effects

Piling effects on prey may cause indirect effects on birds especially if there is concurrent construction over large areas. However, there is currently no standard methodology for assessing these effects and only brief reference is made to them in most Environmental Statements.

Prey effects are likely to be a sensitive issue within the Firth of Forth as the EU funded IMPRESS project (Interactions between the Marine environment, PREdators and prey: implications for Sustainable Sandeel fisheries) resulted in the closure of the Wee Bankie sandeel fishery as a means of addressing the decline of breeding seabirds, in particular sandeel prey specialists such as auks and kittiwakes. Lesser sand eel (*Ammodytes marinus*) is also a priority BAP species (Grouped plan).

FTOWDG is currently considering the way in which piling effects on sandeel prey could be investigated and individual developers have held discussions with Simon Greenstreet (Marine Scotland) and Beth Scott, University of Aberdeen, in relation to this. The group is aware that ecosystem links should be explored and are investigating how data from natural fisheries surveys can be applied to this aspect of ornithological impact assessment. Joint discussions between developers, SNCAs and Marine Scotland are also being progressed so that a coordinated approach to this issue is achieved.

Recommendation: In relation to all of the above, where a species is identified with the potential to experience significant cumulative effects it may be necessary to carry out further investigations using techniques such as population modelling. Details of appropriate species and techniques would be discussed and agreed at each stage with the relevant stakeholders.

Question 9

Are there any obvious candidates for population modeling at this stage? If so, which species?

Species Specific Issues and Data Gaps

The sensitive receptors identified in the revised cumulative ornithology study (AMEC, 2010) are listed in **Table J** together with their susceptibility to individual and cumulative effects. For most species, the data collected during standard surveys will be adequate to assess cumulative effects. However, in some instances, particularly where species are numerous and widespread through all the FTOWDG wind farm sites, additional data may be required. The FTOWDG is currently discussing a number of possible proposals in order to address these specific issues and data gaps and these are briefly described below.

Geese and Swans

SNH and RSPB have expressed concern about potential effects on migratory geese and swans approaching the Firth of Forth and the lack of data relating to these and other migratory species. Currently, FTOWDG is proposing further work on migration movements via SOSS as mentioned previously. In addition, tracking studies for whooper swans have been previously undertaken by COWRIE. Results show the flight lines of 14 Whooper swans through the Firth of Forth region, illustrating that the migration of the tracked birds is generally inshore of the FTOWDG wind farms (Griffin *et al.,* 2010). WWT are also currently analysing all outstanding tracking data recorded to date for satellite-tagged swans and geese as part of a DECC-funded extension to the COWRIE Whooper Swan satellite-tracking project (E. Rees, Pers. comm.) This work is due to be completed in July 2011 and may provide additional specific data on bird movements through the Firth of Forth region. This information can be used by developers to assess the level of cumulative risk of collision or barrier effects from wind farms on the east coast of Scotland.

Gannet

Gannet is present in relatively large numbers throughout the Firth of Forth and Tay region and has the potential for significant cumulative collision impacts. Many of the individuals are likely to have come from the Bass Rock (Forth Islands SPA). However, the foraging range of this species means that individuals may also have come from SPAs further afield. FTOWDG is currently exploring the possibility of data sharing with a NERC-funded gannet tracking project being undertaken on the Bass Rock by Keith Hamer, University of Leeds. This research began in

summer 2010 to investigate the relationship between gannet feeding behaviour and fishing discards.

Information arising from these studies will be helpful in understanding the ranging behaviour and distribution of birds at sea and informing the impact assessment process.

The potential cumulative effects from offshore wind farms on the UK gannet population as a whole has resulted in a proposal that the SOSS group carries out a population modelling exercise relating to the national gannet population and all UK offshore wind farms in order to understand the potential scale and significance of impacts from collision.

Guillemot, Razorbill and Puffin
As with gannet, the large numbers of these species breeding and foraging in the Firths of Forth and Tay mean that cumulative effects are expected. These may include displacement and indirect effects on prey. The significance of displacement effects in particular, depends on the why the bird is present in the region and this will be important to establish, particularly for HRA purposes. Long term studies on the Isle of May carried out by the Centre for Ecology and Hydrology (CEH) have established historic auk foraging ranges, however, confirming current foraging ranges and establishing the nature of any indirect effects on auk prey species will be key to robust impact assessment. Further studies on these species are described in the following paragraphs.

Kittiwake
Kittiwakes nest in significant numbers at several SPAs in the region and, currently, their population is in decline. Research linking this decline to the availability of their main prey item, the lesser sandeel has been enough to maintain the closure of the commercial sandeel fishery on the Wee Bankie since 2000 (Daunt *et al* 2008). As with auk species, knowledge of foraging range and potential indirect construction effects on prey species will be important in assessing the potential direct and indirect effects of the projects.

FTOWDG has commissioned The Centre for Ecology and Hydrology to undertake tracking studies on kittiwake and auk species from the Isle of May (Forth Islands SPA) during summer 2010. As a result, 38 kittiwakes, 35 guillemots and 18 razorbills have been successfully tracked during the breeding season using GPS data loggers. The results of this study are currently being analysed to establish foraging ranges, connectivity between the proposed wind farm sites and the SPA and, potentially, to validate historic data records.

Owing to the difficulties of accessing the other major SPA breeding colonies around the Firth of Forth, studies on these species at additional sites such as Fowlsheugh and St Abbs and Fastcastle have been deferred until at least the 2011 breeding season.

In addition to the above studies it is understood that the RSPB are undertaking a number of tracking studies as part of the Future of the Atlantic Marine Environment (FAME) project. Species include gannet, kittiwake, guillemot, razorbill, fulmar and shag at a range of sites, some of which may be relevant to the study region.

2.4.5 SPAs, Impact Assessment and Habitats Regulations Appraisal

SPAs relevant to the Firth of Forth region are identified in **Section 2.1** of this document. Cumulative effects on relevant sites will need to be assessed within the Nature Conservation section of each Environmental Statement.

It is important that FTOWDG developers make a clear separation between impact assessment and Habitats Regulations Appraisal (Appropriate Assessment)[4], however, both will be challenging where the same species occur at a number of different SPAs, have overlapping foraging ranges or post-breeding distributions or are migratory.

FTOWDG has started the process by compiling maps based on foraging ranges provided in Langston (2010). These identify which SPAs species may be affected by more than one wind farm. Any additional information that can clarify species distribution patterns and SPA connectivity will be extremely useful.

Habitats Regulations Appraisal requires each developer to provide specific information to support decisions about whether their development, alone or in-combination, is likely to have a significant effect on the qualifying features of an SPA and any adverse impact on site integrity. This needs to be based on whether the proposed development will undermine the conservation objectives of the site.

SPA conservation objectives are standard in Scotland and state that specific populations should be 'maintained in the long term', subject to natural change. This approach aims to ensure that where development is proposed, subsequent anthropogenic change will not result in a decline in the population (as distinguishable from the changes which may be caused by natural factors). For this reason, it is usually inappropriate for the SNCAs to define a threshold value of acceptable population decline above which further effects are unacceptable. However, there are exceptions e.g. the definition of hunting quotas for certain goose species.

It may therefore be more helpful for FTOWDG members to consider a risk assessment approach which looks at the likelihood of the population being affected, supported by data including population modelling where appropriate. Presentation of information in this way allows an element of expert qualitative judgment in ascertaining whether an adverse impact is likely, recognising the limitations of gathering scientific evidence of sufficient certainty. FTOWDG developers should ensure that discussions on this topic include both the SNCAs and Marine Scotland who will be responsible for undertaking any Appropriate Assessments.

Table I Summary of ornithology methods and activities agreed between developers.

Method/Activity	Status
Aerial surveys	Raw data shared
Aerial data analysis	Methods to be agreed
Boat- based survey methods	Common methods based on Camphuysen et al 2004 and Maclean et al 2009 agreed

[4] Under Article 6 of the Habitats Directive, an assessment is required where a plan or project is likely to have *a* significant effect upon a Natura 2000 site (SPA or SAC). The requirements of the Habitats Directive are transposed into UK law by means of several pieces of legislation, including: The Conservation (Natural Habitats, & c) Regulations 1994 (as amended in Scotland, most notably in 2004 and 2007), and the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended) which transpose the Habitats Directive in the UK offshore marine area (beyond 12 nautical miles).

Bird surveys	Carried out by individual developers
Density calculations/Use of Distance software	Common methods to be agreed
Data analysis	Carried out by individual developers
Data outputs	Processed data to be shared
Collision risk modelling	Common methods to be agreed
Displacement	To be discussed if quantitative study required
Barrier effects	To be discussed if quantitative study required
Indirect effects	To be discussed if quantitative study required
Information to inform AA	To be discussed with SNCAs

Question 10

It is understood that SNH/JNCC are reviewing the COWRIE guidance and approaches to cumulative assessment in Rounds 1 and 2 development in England and Wales and at other European wind farm sites. Does this review suggest that methods other that the proposed analyses should be used?

2.4.6 Presentation of Results

Matrix tables summarising the significance of cumulative effects for each sensitive receptor at each site should be provided for each category of effect i.e one matrix for collision risk, one for disturbance/displacement etc. The cumulative effects should be discussed based on the magnitude of the impact in relation to the local, regional, and national populations and should reach a summary conclusion stating whether the cumulative effect is significant or not significant. In order for results to be comparable, it will be important for FTOWDG and the SNCAs to agree on definitions of sensitivity, magnitude of effect and impact significance.

Table J Sensitive bird receptors (Amec, 2010).

Species	Effect[1]				Cumulative effects[2]	Sensitivity[3]	Additional data (FTOWDG offshore region)	Example
	C	D	B	H/ P				
Whooper swan	***	*	*	-	High	17		Further information on migration movements WWT.
Bean goose (Taiga)	**	**	*	-	Medium			
Pink footed goose	**	**	*	-	High	15		
Greylag goose	**	**	*	-	High	15		
Barnacle goose (Svalbard)	**	**	*	-	High			
Brent goose (Svalbard)	**	**	*	-	Medium	22		
Shelduck	-	-	-	-	-	5	No	
Greater scaup	*	**	**	**	-	15	No	
Eider	*	*	**	**	Medium	20	No	
Long tailed duck	*	**	**	**	Medium	13	No	
Common scoter	*	**	**	**	Medium	17	No	

Species	Effect[1]				Cumulative effects[2]	Sensitivity[3]	Additional data (FTOWDG offshore region)	Example
	C	D	B	H/ P				
Velvet scoter	*	**	**	**	Medium	27	No	
Goldeneye	*	*	**	**	Medium	16	No	
Red breasted merganser	*	*	**	**	Medium	21	No	
Red throated diver	*	***	**	**	High	44	No	
Black throated diver[NonSPA]	*	***	**	**	High	43	No	
Great crested grebe	-	-	-	-	-	19	No	
Red-necked grebe[NonSPA]	-	-	-	-	-		No	
Slavonian grebe	*	**	**	**	Medium	23	No	
Fulmar	*	*	*	**	Low	6	No	
Sooty shearwater[NonSPA]	*	*	-	-	-	8	No	
Manx shearwater	*	*	-	**	High	10	No	
Gannet	**	*	*	*	High	17	Yes	Tracking: Newcastle; Uni; Kiel Uni.
Cormorant	**	*	**	**	Medium	23	No	
Shag	*	**	**	**	Medium	26	No	Tracking CEH
Pomarine skua[NonSPA]	**	*	*	*	Medium?	10	No	
Arctic skua[NonSPA]	**	*	*	*	Medium	10	No	
Great skua[NonSPA]	**	*	*	*	High	12	No	
Little gull	*	*	*	*	?	13	No	
Black headed gull[NonSPA]	*	*	*	*	Low	8	No	
Common Gull[NonSPA]	*	*	*	*	Medium	12	No	
Lesser black backed gull	**	*	*	*	High	14	No	
Herring gull	**	*	*	*	Medium	11	No	
Greater black-backed gull[NonSPA]	**	*	*	*	Medium	18	No	
Kittiwake	**	*	*	*	Low	8	Yes	Tracking (CEH; RSPB; Newcastle Uni)
Little tern	*	*	*	**	Medium	24	No	

Species	Effect[1]				Cumulative effects[2]	Sensitivity[3]	Additional data (FTOWDG offshore region)	Example
	C	D	B	H/ P				
Sandwich tern	**	*	*	**	Medium	25	No	
Common tern	**	*	*	**	Medium	15	Yes	Tracking (JNCC)
Roseate tern	**	*	*	**	Medium	21	No	
Arctic tern	**	*	*	**	Medium	13	Yes	Tracking (JNCC; Newcastle Uni)
Guillemot	*	**	**	**	Medium	12	Yes	Tracking and prey studies
Razorbill	*	**	**	**	Medium	15	Yes	Tracking and prey studies
Puffin	*	**	**	**	Medium	15	Yes	Newcastle Uni

Non SPA species are indicated by the superscript text [NonSPA]

1 Sensitivity to effect taken from Table 2 in Langston, R. (2010) Offshore Wind Farms and Birds. RSPB Report No. 39, RSPB, Sandy, UK. 40 pp. * = Low risk; ** = Medium risk; 3 = High risk. Effects: C= collision; D = Displacement; B = Barrier; H/P = indirect effects on habitat and prey.

2 Cumulative effects are taken from Langston (2010) and indicate the perceived cumulative risk at the GB/UK population level from offshore wind farm developments

3 Species sensitivity scores derived by Maclean in King et al 2009 based on a range of sources including Garthe and Huppop (2004)

2.5 Marine Mammals

2.5.1 Potential Effects

Based on available literature and consultation with the SNCAs the following are perceived to be the main potential effects on marine mammals as a result of wind farms within the marine environment:

- Disturbance or physiological effects as a result of underwater noise arising from construction, operational and maintenance activities associated with the wind farm development(s);
- Potential longer term avoidance of the development area by marine mammals;
- Increased collision risk due to construction and maintenance traffic;
- Potential reduction of the feeding resource due to the effects of noise, vibration, and habitat disturbance on important prey species; and
- Conflict with commercial fisheries as a result of increased effort within reduced fishing areas.

Underwater Noise

It is perceived that the most significant potential disturbance of marine mammals from offshore wind farms arises from underwater noise associated with pile-driving activities during installation.

Whilst developers will consider a realistic worst case scenario when assessing cumulative effects, it is unlikely, due to water depth and the nature of the local seabed sediments, that all wind farms will have monopile foundations.

The effects of noise on marine mammals can be classed into three groups:

- Primary effects – such as immediate or delayed fatal injury of marine mammals near powerful sources e.g. explosive blasts underwater;
- Secondary effects – such as physiological injury (including Permanent or Temporary Threshold Shift – PTS and TTS) which may have long term implications for survival; and
- Tertiary (behavioural) effects – such as avoidance of the area or masking of sounds that may have significant effects where the manmade source is in the vicinity of breeding grounds, migratory routes or feeding areas.

Under the terms of the EU Habitats Directive it is an offence to cause 'deliberate disturbance' to a European Protected Species (EPS); all cetaceans are classed as EPS. JNCC has produced guidance as to how this should be applied in all UK waters with the exception of Scottish Territorial Waters, however, in the absence of further guidance from SNH, the FTOWDG members will be applying this guidance across their entire study area.

The JNCC Guidance (draft March 2010) proposes that:

- *'a permanent shift in the hearing thresholds (PTS) of an EPS would constitute an injury offence. The Southall et al. (2007) precautionary criteria for injury are based on quantitative sound level and exposure thresholds over which PTS-onset could occur. If it is likely that an EPS could become exposed to sound at or above the levels proposed by Southall et al. (2007) then there is a risk that an injury offence could occur. The risk of an injury offence will be higher in areas where EPS occur frequently and/or in high densities.*

- *'The disturbance offence catches disturbance which is significant in that it is likely to be detrimental to the animals of an EPS or significantly affect their local abundance or distribution. Such disturbance could therefore be likely to increase the risk of a negative impact to a population of an EPS at Favourable Conservation Status (FCS) in their natural range. Sporadic disturbances without any likely negative impact on the species, i.e. trivial disturbances such as that resulting in short term behavioural reactions, are not likely to result in an offence being committed...The risk of a disturbance offence being committed will therefore exist if there is sustained noise in an area and/or chronic noise exposure, as a result of an activity. The risk is likely to be higher in regions where there are semi-resident populations or where animals of a species occur frequently and in high densities.'*

2.5.2 Study Area

The outer region of the Firth of Forth and Tay Estuary is important for marine mammals. In defining the cumulative study area for marine mammals it is necessary to consider the area over which animals, which use the waters of the Firth of Forth and Tay, range. For marine mammals such as minke whales or harbour porpoise and some seals, this could include most of the UK waters and international waters beyond.

Given the applicability of the COWRIE methodology (see Ornithology **Section 2.4**) to mobile and wide-ranging species, the approach described in **Section 2.4** has also been applied to the identification of cetacean and other marine mammal species that may be susceptible to cumulative effects. The species listed below are those that are expected to require consideration in terms of potential cumulative effects:

- Common seal;
- Grey seal;
- Harbour porpoise;
- Bottlenose dolphin;
- White-beaked dolphin; and
- Minke whale.

Nationally important numbers of grey and common seals forage within this area. Protected haul out sites for both species are located within 20km of nearest wind farm site. Furthermore, the grey seals found within Forth and Tay are not ecologically isolated from animals found at the Farne Islands, Northumberland, or the breeding sites in the far north of Scotland (McConnell *et al*. 1999).

Six cetacean species occur frequently within the study area. Bottlenose dolphins from the Moray Firth SAC are frequently recorded within the Firth of Tay and Forth Estuary (SNH, 2006).

In order to ensure the study area is reasonable, assessments will focus on the North Sea from the Moray Firth to the Farne Islands off the Northumberland coast. However, for certain species contextual information may be sought for regional seas or wider UK waters.

Question 11

Is the proposed Study Area appropriate? (If not, what alternative would you propose?).

2.5.3 Data Gathering

Desk-based review of marine mammal data

A desk-based review of data covering the study area will be necessary to provide an initial assessment of the existing information on the occurrence and distribution of marine mammals in the waters of the Forth and Tay. The review should build upon data already presented in scoping reports for FTOWDG sites and also include detail from incidental marine mammals sightings data gathered during aerial bird surveys of the region to date. The review process would be expected to result in a single technical report made available to all the FTOWDG members.

A brief summary of key existing data sources is provided in **Tables K and L** below. The abundance and distribution of grey and common seals within the study area is well characterised. Compared to seals, cetacean population dynamics are less well characterised within the study area.

Table K Existing data on seals for the Forth and Tay study area

Data	Coverage	How will it inform the EIA	Data holder

Data	Coverage	How will it inform the EIA	Data holder
Grey seal haul out counts	UK wide	Haul out distribution and abundance of grey seals across the study area.	SMRU
Common seal haul out counts	UK wide	Haul out distribution and abundance of common seals across the study area.	SMRU
Grey seal telemetry data	Isle of May –track data from post weaning pups tagged Tay and Eden SAC-multiple deployments. Dates TBC Farne Islands- grey seals from this colony tagged in 2008 known to use Forth and Tay (Dr C Sparling, *pers comm.)*	Utilisation of at-sea space for grey seals within the study area. Data will also describe the relative importance of certain areas, as a function of foraging and migratory behaviour. C.f. Mathiopolous	SMRU
Common seal telemetry data	Tay and Eden SAC – harbour seals tagged in 2000	As above	SMRU
Stranding surveys	UK wide	As part of the site characterisation it would be informative to establish the pre-construction baseline level of seal carcass incidents.	SNH and SMRU

Table L Existing cetacean data and ongoing surveys within the study area

Data	Coverage	How will it inform the EIA	Data holder
JNCC Atlas of Cetacean Distribution (Reid et al. 2003).	UK wide	The spatial and temporal patchiness of this data source will limit it's usefulness in terms of an accurate site characterisation.	JNCC (publically available)
Stranding data	Scotland-wide	Stranding data can provide an indication of the cetacean species likely to inhabit the study area.	SNH/ SMRU
FTOWDG Marine Mammal Observer (MMO) Surveys	Forth and Tay study area	Ship-based transect line surveys will provide information on spatial and temporal variation of species sightings within the study area.	FTOWDG
Fine-scale sightings information for bottlenose dolphins	TBC	SMRU holds a significant amount of fine-scale sightings data from the Tay area. The spatial and temporal coverage of this data will be confirmed by Dr Nicola Quick during ongoing consultation between SMRU and FTOWDG.	SMRU

Desk-based review of existing pinniped telemetry and haul out count data

As identified in **Table K**, there is a significant amount of information regarding at-sea usage for both common and grey seals around the Scottish coast. This data will allow the EIAs to establish seasonal trends for breeding, foraging and migratory activity within the study area, c.f. Matthiopoulos *et al.* (2004). It has been proposed that SMRU ltd. will undertake a desk-based review of existing common seal and grey seal telemetry data and recent haul out count data of both species in order to reveal areas of relative importance within the study area.

The work described above may be augmented by an assessment of the use of sea space by common and grey seals to describe the relative importance of these sea areas for each species. Where data allows, this could include analysis of key details of dive metrics within these zones which may provide an indication of foraging behaviour (e.g. swim speeds, dive depths).alongside an assessment of the importance of areas for transiting seals travelling to foraging locations out-with the boundaries of developments. This could involve a consideration of the energetic consequences of avoidance during construction and/or operation.

This work would allow developers to consider their wind farm development areas in context of the wider distribution of seals in the area.

Ongoing boat-based marine mammal transect surveys

FTOWDG members have commissioned boat-based MMO surveys of their respective wind farm sites. These surveys target both birds and marine mammals. Although surveys are being undertaken on a site-specific basis, data collection methods have been standardised to ensure that data can be shared across the group.

It is recognised that the outer Forth and Tay wind farm developments cannot be assessed in isolation; and it has been agreed by developers that all marine mammal data will be shared, with distribution or abundance maps produced using this information then shared across the developer group. This should achieve a more meaningful characterisation of marine mammal abundance, distribution and seasonality across the wider study area than could ever be achieved by the data for the individual sites in isolation.

Baseline Noise Survey

Background noise measurements (i.e. pre-installation) will be gathered to provide contextual information for subsequent noise assessments and any subsea noise modelling undertaken. It is proposed that measurements will be gathered across all sites and in surrounding waters. Noise will be measured from both natural (wind, wave, seismic activity) and existing anthropogenic sources (seismic surveys, land based construction, shipping activities). Once a noise map of the region is developed, the noise measurements from developer studies can be used to ground truth any models developed.

Question 12

Are you aware of any additional data sources that should be considered in the assessment?

2.5.4 Data Analysis

Noise modelling

FTOWDG members are yet to confirm turbine installation methods. However, it is recognised that if developers plan to undertake pile driving activities during constriction, some form of noise modelling will be required in order to predict the likely effects on marine mammals.

Recommendation: The FTOWDG will work with subsea noise specialists and marine biologists to produce a regional underwater noise map and model. The noise map will show the existing noise fields in the study area whilst a noise model will allow individual developers to input scenarios into a noise model to show the potential noise fields generated from their own and other developers / other industry activities. It is intended that any model would be capable of providing outputs to support assessments for both marine mammals and fish.

BAE Systems has proposed an approach to noise modelling that is currently under consideration by the FTOWDG. The BAE proposal offers an advanced, well-structured and iterative approach to assessing potential noise effects from wind farm construction activities. It aims to provide the developers with a risk assessment framework to calculate the probable numbers of marine mammals affected by anthropogenic underwater noise. The modelling process is shown below in **Figure B**. It utilises existing modelling software[5] and a risk assessment framework familiar to SNH and the JNCC.

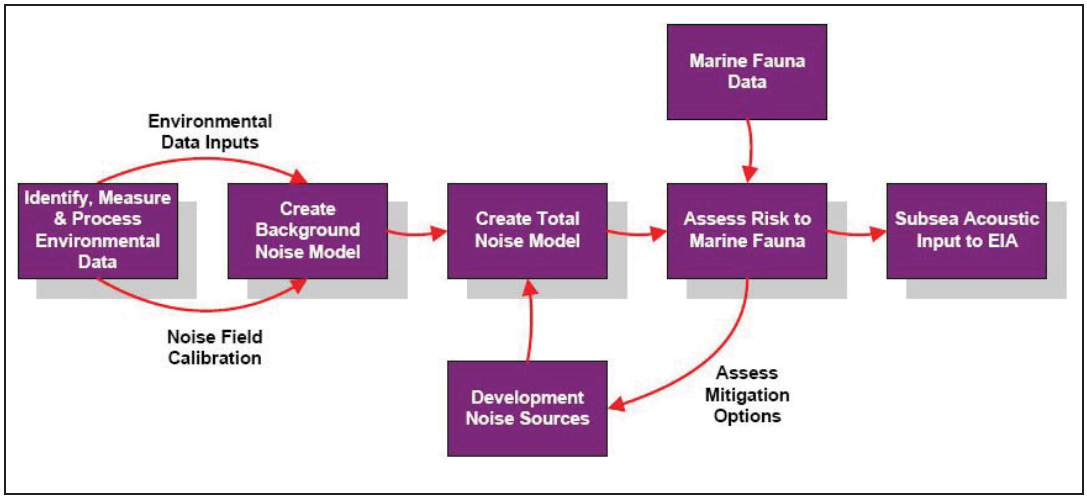


Figure B BAE Systems Noise Modelling Approach

It should be noted that the FTOWDG is also investigating other approaches to noise modelling. The Subacoustech model, developed by Nedwell *et al.* (2007) offers an alternative approach to assessing the effects of noise exposure to fish and marine mammals. It relates the strength of a noise emission to the hearing threshold of a species (dBht(species) approach). This application of the dBht(species) approach to hearing damage has been challenged by SMRU (SMRU 2007 as cited in Diederichs *et al.* 2008) and it is unresolved whether the dBht(species) approach can be

[5] DINAMO (Directional Noise Array Model) which calculates ambient noise levels, and ERMC (Environmental Risk Management Capability) which performs risk assessment and mitigation.

applied over the whole range of a species hearing abilities (see Nehls *et al.* 2008). As a result, consultation is still ongoing whether the noise emission injury radii presented in Southall *et al* (2007) offers the FTOWDG the best alternative.

On the basis of model outputs, potential cumulative effects will be assessed by individual developers within their EIAs in a standardised manner.

The FTOWDG propose using the thresholds described within the JNCC disturbance guidance to assess whether European Protected Species are likely to be subject to 'deliberate disturbance'. JNCC state that:

- 'If there is a risk of injury or disturbance of EPS that cannot be removed or sufficiently reduced by using alternatives and/or mitigation measures, then the activity may still be able to go ahead under licence, but this should be a last resort. A licence should only be granted if the activity fits certain purposes, if there is no satisfactory alternative and where the activity will not be detrimental to the maintenance of the populations of the species concerned at a [Favourable Conservation Status] FCS in their natural range.'

For the purposes of the assessments, the FCS[6] of a species will be taken to be that as described within the JNCC Guidelines.

Longer Term Avoidance of the Area

Recommendation: Using a noise model should allow developers to assess the temporal and spatial nature of marine mammal avoidance behaviour within the study area. For the purposes of the noise assessment, it will be assumed that once a marine mammal has been exposed to noise levels exceeding TTS, it will leave the vicinity of the operations and not return. In order to assess the potential for this to impact upon marine mammals at a population level, the number of marine mammals deemed to have 'left' the region will be placed in context with the number of animals expected to use the region over a set period (e.g. a season or a year).

Potential reduction of the feeding resource due to effects of underwater noise, vibration and habitat disturbance on important prey species;

In order to assess the potential cumulative effects of wind farm developments on marine mammal foraging opportunities it is necessary to determine the important prey species for marine mammals.

Recommendation: The desk-based review described above, will aim to provide a qualitative assessment of the diet of key marine mammals known to forage within the study area. It is

[6] Member states report back to the EC every six years on the conservation status of marine EPS (see http://www.jncc.gov.uk/page-4063). The UK assessed 6 out of 11 species of cetaceans as Unknown FCS, mainly as a result of the fact that either there were no recent population estimates that encompassed the natural range of a species in UK and adjacent waters, and/or there was no evidence to assess trends in population abundance. Another 17 species considered to be uncommon, rare or very rare in occurrence, so it was not possible to ascertain their conservation status. Five species were assessed as favourable FCS, however the reliability of these assessments was moderate to low.

anticipated that many of these prey species will be subject to cumulative impact assessment as described in other sections of this report (e.g. Natural Fishery Resources; Benthic Ecology).

It will be important to consider any effects on prey resources in the context of wider ecological dynamics, commercial fishing and climate change. Assessing the biological significance of impacts to prey species is challenging, however, the dietary specialisations or opportunistic nature of different marine mammals may determine their ability to adapt to potential short-term or long-term changes in prey availability.

Collision Risk and Indirect Effects

Recommendation: Given the amount of shipping traffic already operating in the Firth of Forth and Tay, the FTOWDG believes it is unlikely that vessel traffic will increase the risk of collision with marine mammals. In order to demonstrate this, the information from the shipping surveys already being undertaken for the FTOWDG will be used by all developers as a baseline for existing activities. Using the Rochdale Envelope for the entire region, an estimate of the increase in shipping traffic associated with the wind farms will be made.

In order to minimise the collision risk from increased shipping activity, particularly during the construction phase, a mitigation strategy will be agreed by all developers in consultation with SNH.

Table M, below, summarises the key surveys and other activities agreed by FTOWDG.

Table M Summary of marine mammal surveys and desk-based studies agreed between developers

Method/Activity	Status
Boat- based visual surveys of marine mammals	Common methods agreed and approved by JNCC/SNH, raw data to be shared
Noise modelling	Regional approach to modelling – shared FTOWDG exercise
Other data analysis	Common methods to be agreed – scope for collaborative studies
Information to inform AA	To be discussed with SNCAs

Question 13

Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).

2.5.5 Presentation of Results

The findings from the research activities described above will presented in technical reports. These technical reports will inform the cumulative effects assessment component of the individual site EIAs, which will need to consider those sensitive species identified under **Section 2.5.4**.

2.6 Natural Fishery Resources

2.6.1 Potential Effects

In order to establish potential effects it will be fundamental to understand the resource present. This will be achieved through reviewing the documentation produced (during the various site bid phases) by the FTOWDG members to date.

Cumulative effects with another development can only exist if it has been reasonably determined that the potential effect manifests at the site level. Therefore, once an overview of the likely resource (in terms of key species and spawning grounds present) is established it will be possible to identify potential effects. This will comprise consideration of discrete areas such as individual spawning and nursery grounds or larger scale distribution of resource across all of the wind farm sites.

It is proposed that the methods described in King *et al.,* (2009) including the use of sensitivity matrices are adapted for this task and that all potential impacts (e.g. avoidance, disorientation, delayed migration) and impact receptor pathways (during construction, operation and decommissioning phases of the project) and which species are anticipated to be affected are identified.

These effects will then be screened for potential for cumulative impact, through a series of matrices that will assess:

- Effects vs. projects - to identify where effects influence may overlap (i.e. where effects are identified for two or more wind farms)
- Effects vs. project programmes - to determine temporal and spatial overlap (and hence identify the potential for a project cumulative impact to exist)
- Impact vs. cumulative effects – to identify extent of cumulative impact e.g. synergistic or additive (as for direct habitat loss)

Potential effects need to be considered from a resource perspective. Effects may be associated with discrete areas such as spawning and nursery grounds, or larger scale effects which would encompass all wind farm sites.

Based upon the findings of the first Discussion Document and stakeholder consultation, the following list highlights what are thought to be key issues relating to natural fish resources:

- Disturbance as a result of elevated construction and operational sound levels (and its effects on spawning grounds, noise effects on predator-prey interactions e.g. effects on sandeel resource in relations to bird feeding etc);
- Barrier and displacement effects (noise and potential EMF);
- Disruption of spawning and nursery grounds (direct and indirect e.g. noise);
- Loss of habitat; and
- Potential changes in food resource due to noise or habitat disturbance.

The most serious potential disturbance to the natural fish resource from offshore wind farms identified to date arises from underwater noise associated with percussive piling activity during the construction phase, where wind turbine generator (WTG) foundations comprise a monopile design. Establishing whether there is potential for spatial overlap of noise effects will be one of

the key components of this stage. Considerable data are available from existing wind farm developments around the UK on the zone of effects from piling activity on fish resource. Whilst it is recognised that this zone is influenced by receptor sensitivity, seabed conditions and foundation specification, it is considered that there is sufficient understanding of this issue to make initial recommendations on potential ranges of effects in order to inform whether it requires cumulative impact consideration.

Once this phase of work has been drafted agreement will be sought with regulators and key stakeholders at the earliest possible juncture on:

- The species to be assessed in both EIA and Cumulative Effects Assessment;
- Identification of key grounds/areas e.g. spawning, nursery etc;
- Definition populations and distributions where possible; and
- The likely sources of cumulative impact.

2.6.2 Study Area

Once the potential effects are established it will be possible to define a suitable study area for the Cumulative Effects Assessment for natural fish resource.

The size of the study area will be dependant on the type of impact and the extent of the resource which may be impacted. These extents are anticipated to be determined as follows:

- Migratory fish – extent may extend inland depending on the location of the Special Areas of Conservation (SAC) for which these species are an interest feature;
- Noise modeling – extent will be determined by the most sensitive species i.e. herring;

Once established it will be necessary to seek agreement with key stakeholders on the justification of the scale of the study area.

Question 14

Is the proposed Study Area appropriate? (If not, what alternative would you propose?).

2.6.3 Data Gathering

Cumulative effects assessment is generally based on existing data collected at the EIA level for individual projects, rather than acquiring new broad scale data. As such it is imperative for the FTOWDG members that the data collected at EIA level is undertaken in a consistent manner and at a suitable geographical and or temporal scale to enable a robust assessment of cumulative affects for the whole Firth of Forth development area. The findings of the early stages of the cumulative impact assessment (as detailed above) are taken into consideration at an early stage so that the can help inform the individual project data collection specification.

Furthermore, this site specific data collection approach and analysis must be standardised across all FTOWDG members, thus enabling data sharing and application of a common framework to the assessment of cumulative effects on fish resources within project EIAs.

It is anticipated that individual project data collection will comprise a detailed desk based study aimed at characterising the fish resource for the wind farm sites and export cable corridors as

part of the EIA process. It will aim to determine the relative abundance, distribution, seasonality and behaviour of fish resources in the area from existing survey data sets including the identification of rare or vulnerable species.

In certain cases where data collection requirement covers the whole FTOWDG study area (such as broad scale data sets held by Marine Scotland) it is recommended that a combined approach should be undertaken and the information for all sites requested simultaneously in order to streamline the approach and reduce data costs.

With data acquisition costs in mind, it is considered that a key route to obtaining data of a scale suitable for addressing broad scale cumulative concerns will be through exploring with Marine Scotland where data from ongoing broad scale survey programmes, (such as those listed below) would be fit for purpose for the characterisation of baselines, assessment of effects and future monitoring. This should include the exploration of data from:

- The Research Vessel Survey Programme e.g.;
  - International ground fish survey results;
  - Nephrops TV surveys;
  - East Coast Scallop Surveys;
  - North Sea Sandeel survey (and more detailed surveys such as those undertaken by Greenstreet *et al*);
- The Observer Programme (obtaining this data may require going down the Freedom of Information Act (FOI) route but this is acknowledged by Marine Scotland and Cefas);
- The Market Sampling Programme;
- Scottish Industry/ Science Partnership (SISP);
- Findings from European Union studies including;
  - IMPRESS - Interactions between the marine environment, predators and prey: implications for sustainable sandeel fisheries.
  - ELIFONTS - Effects of Large-scale Industrial Fisheries on Non-Target Species, 1997-1999.

In all likelihood the available existing data will prove to be insufficient to fully characterise the baseline for an individual project in order to undertake impact assessment. Therefore, it is anticipated that this existing data will be supplemented with site specific data acquired through dedicated field survey.

Such surveys will only be carried out where FTOWDG members have established that there is a testable hypothesis that necessitates collection of additional data. Where surveys are commissioned comparable methodologies between sites will aid in the comparability of data for Cumulative Effects Assessment. Prior to the commissioning of specific resource surveys (e.g. defining the boundaries of a herring spawning site) it should be established if the resource is likely to be impacted by more than one wind farm site, in which case survey developers could look to pool resources.

The scope and scale of these surveys will be established through consultation with Marine Scotland.

Question 15

Are you aware of any additional data sources that should be considered in the assessment?

2.6.4 Data Analysis

The cumulative effects assessment will need to be quantitative in nature where possible to ensure rigor and robustness of the process. This will be made possible only if all FTOWDG members agree to the adoption of a standardised approach to data collection and data analysis.

It is acknowledged that the following effects are likely to be the focus of any assessment for the FTOWDG area:

- *Disturbance as a result of elevated construction and operational sound levels;*
- *Barrier and displacement effects; and*
- *Direct habitat disturbance.*

Considerations for the proposed approach to data analysis for these key effects are detailed below. It is anticipated that the detailed scope of the analyses will be established following consultation with Marine Scotland and other relevant stakeholders.

Disturbance as a result of elevated construction and operational sound levels

Recommendation: It is proposed the following actions are undertaken:
- Calibrate noise models through field data measurements;
- Establish and include appropriate behavioural and impact thresholds for the key fish species; and
- Prior to commissioning of contractor assess the differences in current noise modelling techniques and ensure that the regulator is in agreement with the preferred approach and modelling methodology (assuming at this stage that the same model used to consider effects on marine mammal species will also be used to consider effects on fish species).

Barrier and displacement effects

Recommendation: It is proposed the following actions are undertaken:
- Identify the extent of use, seasonality and fish behaviour for migratory species as well as assess the potential risks of effects such as avoidance, disorientation and delayed migration; and
- Review the extent of information covered and data gaps in the *review of migratory routes for Atlantic salmon, sea trout and eels relevant to Scotland* carried out by Marine Scotland.

Direct habitat disturbance

Recommendation: Cumulative impact of direct habitat loss or disturbance assessed through the summing of effects from each component project and presenting this as a percentage/proportion and assessing the potential population affects appropriately (e.g. for discrete grounds such as herring spawning grounds, nephrops etc).

Table N, below, summarises the main methods and activities agreed by FTOWDG.

Table N Summary of fish resource assessment methods and activities agreed between developers

Method/Activity	Status
Hypothesis driven fish surveys (e.g. herring spawning sites)	Raw data shared, potential to combine surveys if multiple wind farms sites impact the same discrete resource
Survey data analysis	Common methods to be agreed
Boat- based survey methods	Common methods to be agreed
Desk based review of existing information	Combined exercise
Analysis of existing data	Common methods to be agreed
Regional noise modelling	Combined exercise with remit to cover both fish and marine mammals
Geophysical and benthic surveys	Standardised approach across sites
Displacement	To be discussed if quantitative study required
Barrier effects	To be discussed if quantitative study required
Indirect effects	To be discussed if quantitative study required

Question 16

Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).

2.6.5 Presentation of Results

Cumulative effects will be considered within each of the Environmental Statements produced for each development, using standardised impact assessment criteria which will be agreed by FTOWDG members and with Marine Scotland, SNH and the JNCC.

2.7 Shipping and Navigation

Current assessment methodologies employed in determining the effects on shipping and navigation of individual wind farm developments go some way towards considering cumulative effects arising from multiple site development. However, methods do not lend themselves to fully assessing the effects of multiple wind farms in such close proximity.

Recommendation: The FTOWDG commissioned Marine and Risk Consultants Ltd (MARICO) to develop a methodology that will assess the cumulative navigational effects associated with the proposed offshore wind farm developments off the Firths of Forth and Tay. MARICO has developed a regional navigational assessment aimed at holistically identifying the critical cumulative effects of all wind farms on safe navigation. The main goal of the regional assessment is to understand current shipping levels and routes and consider means by which navigational hazards can be mitigated and the safe transit of vessels through the area can be preserved.

The regional assessment relies on appropriate data collection, on which analysis routines are carried out to determine the best possible wind farm layout to minimise navigational risk and maintain safety. A series of analysis routines are proposed that will provide insight into changes in navigational risk brought about by directing vessels around and through the wind farm sites.

The results of the assessment would form a Navigation Cumulative Assessment report. Individual developments would utilise the data collected to undertake their own risk assessments to determine optimum site layouts and take appropriate mitigation measures as decided through discussion with stakeholders and regulators. It is not the intention of this assessment to dictate individual site layouts, alterations to site boundaries or any mitigation measures.

2.7.1 Potential Effects

Assessment of potential effects on navigation will take account of both vessels transiting through the wind farm sites and those vessels transiting in close proximity (hereafter referred to as Non-Transiting Vessels).

In terms of potential effects and hazards, changes in the following hazard risks (probability of occurrence & hazard consequences) may be brought about by placement of offshore wind farms (either individually or collectively). These potential effects are separated into 'hazard risks' and 'operational costs', and may include those listed in **Table O**.

Table O Potential Effects on Shipping and Navigation

Commercial Vessels		Fishing Vessels		Recreational Craft	
Hazard Risks	Operational Risks	Hazard Risks	Operational Risks	Hazard Risks	Operational Risks
• Grounding • Collision • Foundering • Contact	• Diverting from routes • Increase fuel costs • Time costs	• Collision • Foundering • Contact • Snagged nets	• Diverting from routes • Increase fuel costs • Time costs • Loss of fishing grounds (considered under 'Commercial Fisheries')	• Collision • Foundering • Contact	• Diverting from routes • Increase fuel costs • Time costs • Loss of sailing area

The proposed wind farms will take up a portion of navigable water in the approaches to the Firth of Forth and Firth of Tay, and hence part of these areas may no longer be available for transiting vessels (see **Figure C** for current vessel tracks). If the current level of vessels transiting in the vicinity of the proposed wind farms continues, then vessels will be funnelled between the wind farms. Vessels will therefore be forced to avoid the wind farms and hence the current routes used by vessels navigating in the area may change. The extent to which this will effect navigation can only be known once the regional assessment is undertaken.

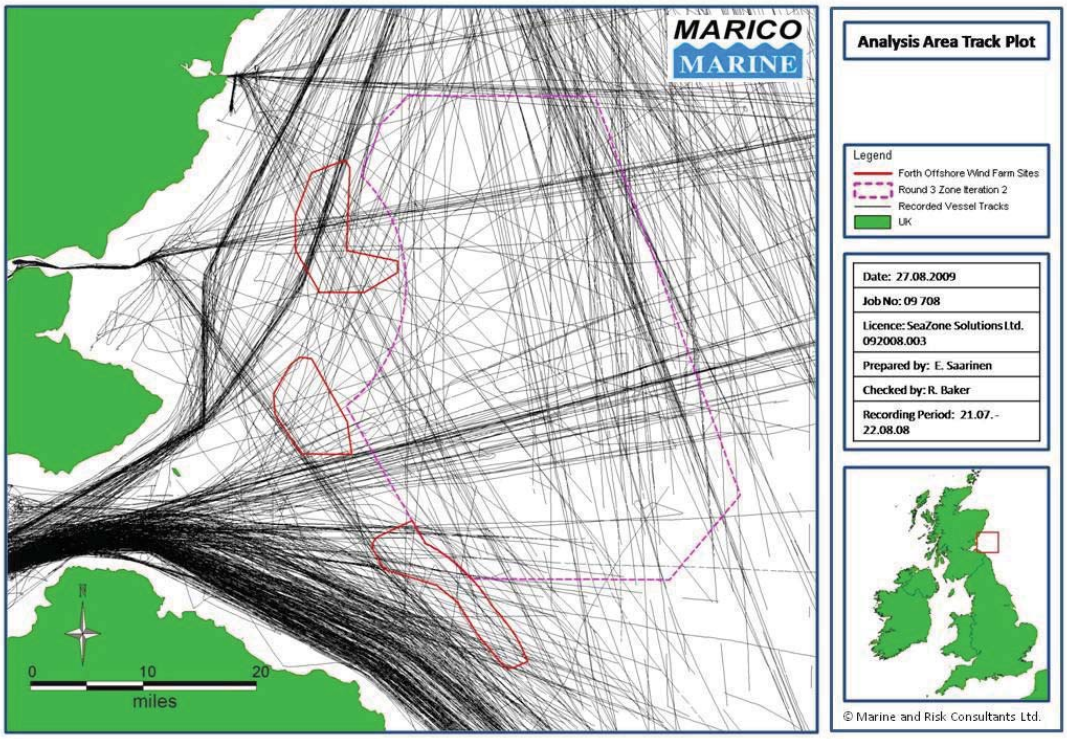


Figure C AIS Vessel Tracking Example Output

2.7.2 Study Area

The study area will encompass:

- Wind farm sites;
- Export cable routes; and
- Construction traffic routes.

In terms of temporal boundaries the main stages of the wind farm projects will be considered. This therefore includes:

- Site assessment (e.g. survey vessel activity);
- Wind farm construction (taking into account the multiple wind farm construction);
- Wind farm operation (including maintenance); and
- Wind farm decommissioning.

Question 17

Is the proposed Study Area appropriate? (If not, what alternative would you propose?).

2.7.3 Data Gathering

A variety of data will be gathered to characterise shipping activity across the study area. Data gathering will involve both desk-based collation of existing information and field surveys. Data sources are summarised in the text below and collection methods are summarised in **Figure D**.

Maritime Data

The Department of Energy and Climate Change (DECC) provides a web site from which it is possible to download various shipping data. The database provides information on commercial shipping, fishing and recreational craft. Data sets include shipping density, fisheries surveillance records, and recreational cruising routes, racing areas and sailing areas.

Automatic Identification System Data

Automatic Identification System (AIS) data is transmitted from vessels to improve safety, specifically collision avoidance. All ships of 300 gross tonnage and upwards engaged on international voyages, cargo ships of 500 gross tonnage and upwards not engaged on international voyages and all passenger ships irrespective of size carry automatic identification systems (AISs) capable of providing information about the ship to other ships and to coastal authorities automatically.

AIS provides information - including the ship's identity, type, position, course, speed, navigational status and other safety-related information - automatically to appropriately equipped shore stations, other ships and aircraft. **Figure C** shows AIS vessel track recordings across the study area.

Radar Data

A vessel can be tracked by radar to give its range, direction and speed, and from this the vessels course can be derived. Radar has a distinct advantage over AIS as all recording equipment needed for data collection can be tested and calibrated, and is not reliant on “onboard” or third party equipment. Radar will also pick up vessels that do not carry AIS.

Vessel Monitoring Data

Satellite vessel monitoring systems (VMS) are used as part of the sea fisheries enforcement programme, to track the positions of fishing vessels over 15 metres in overall length in UK waters. It is also used to track all UK registered fishing vessels globally. VMS data for the study area can be obtained from Marine Scotland (Compliance).

Data collected includes:

- Since 2000, two-hourly position reports from UK vessels over 24 metres in length; and
- Since 2005, two-hourly position reports from UK vessels over 15 metres in length.

Fishing Vessel Surveillance Data

Surveillance data of fishing vessels from fishery protection aircraft and fishery protection vessels has also been collected historically, and is again available from Marine Scotland (Compliance).

UK Coastal Atlas of Recreational Boating

In 2005 the Royal Yachting Association compiled and presented a comprehensive set of charts which defined the cruising routes, general sailing and racing areas used by recreational craft around the UK coast.

Additional Desk Based Investigation

Desk based investigations into recreational craft usage can give a clear indication of recreational traffic within the proposed wind farm area. Investigation would be in line with the data used to create the RYA UK Coastal Atlas of Recreational Boating though it should be more up to date, Investigations should be based on reference material, e.g.:

- Standard Publications
  - Almanacs,
  - Charts, and
  - Pilots Books
- Web Information
- Consultation

Survey

The cumulative effects assessment undertaken for FTOWDG is being supported by AIS survey of the study area to ensure that shipping activity is fully captured and understood.

	Desk Based Study	Shore Based	Vessel Based	Third Parties
Commercial Vessel Data				
Site Investigations	✓	×	×	×
Automatic Identification System Data	×	✓	✓	✓
Radar Data	×	✓	✓	×
Recreational Craft Data				
RYA Routes Database	×	×	×	✓
Site Investigations	✓	×	×	×
Fishing Vessel				
Vessel Monitoring Data (From 2000 LOA >24m & From 2005 LOA >15m)	×	×	×	✓
Fishing Vessel Surveillance Data (195 onwards)	×	×	×	✓
Site Investigations	✓	×	×	×
Automatic Identification System Data (vessel > 300gt only)	×	✓	✓	✓
Radar Data	×	✓	✓	×

Figure D Data sources.

Question 18

Are you aware of any additional data sources that should be considered in the assessment?

2.7.4 Data Analysis

Gathered data will be analysed to determine vessel characteristics, vessel tracks and vessel density across the study area, and then to consider navigational risk and to identify options to minimise navigational risk and maintain safety throughout wind farm development.

Technical details of proposed methods of analysis are provided in **Appendix E**, and methods are summarised briefly below.

Preliminary Hazard Assessment

Following navigational data analysis, a Preliminary Hazard Assessment (PHA) process will be undertaken in line with International Maritime Organisation guidance. The PHA is aimed at identifying all potential hazards (i.e. in terms of those listed in **2.7.1** above) to shipping and navigation associated with wind farm development and determining possible mitigation or risk control options. Consideration will also be given to potential effects on aids to navigation (e.g. RADAR, GPS etc).

In order to assess the practical aspects of any proposed scenario, the overall output will be subjected to further scrutiny by qualified mariners to ensure that the scientifically derived solution is in line with expert judgement. This judgement should be made by suitably qualified mariners (e.g. Class 1 Master Mariner(s), with experience of navigating in the area). Discussions will be held with the developer group prior to making any judgement or drawing conclusions on the given output.

The results of the PHA assessment should feed back into the data analysis phase to ensure any recommendations do not adversely affect any other aspect of navigational safety.

Consultation

Consultation with a defined set of navigational stakeholders, representative of the area will be undertaken as part of the PHA process in the form of a stakeholder workshop. This will allow local users to analyse the outputs of the analysis, pass judgement and assess the hazards posed by the installations. The process will also enable the stakeholders to provide input on mitigation and risk control measures. A representative sample of stakeholders will be identified during the data analysis stage.

Figure E below summarises the regional cumulative effects assessment methodology in its entirety.

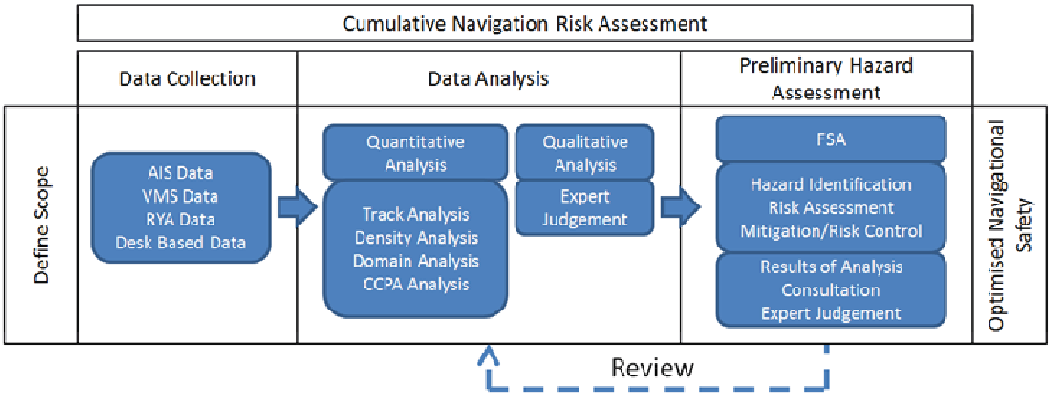


Figure E Shipping and navigation cumulative effects assessment process.

Table P Summary of shipping and navigation methods and activities agreed between developers.

Method/Activity	Status
AIS Survey	Commissioned by FTOWDG to cover whole study area
Regional data gathering	Undertaken on behalf of all FTOWDG members
Data analysis – regional navigation assessment and consultation	Undertaken on behalf of all FTOWDG members

Question 19

Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).

2.7.5 Presentation of Results

Assessment outcomes will be presented in a stand alone regional assessment report, which would provide details on optimised wind farm boundaries and risk control measures for construction, operation and decommissioning of the Forth and Tay offshore wind farms. It is anticipated that the report would contain the following sections:

- Introduction;
- Data collection methodology;
    - Commercial vessels;
    - Fishing vessels; and
    - Recreational craft.
- Proposed site boundaries (supplied by developers);
- Proposed construction time line (supplied by developers);
- Analysis of proposed layouts;
    - Track analysis(including plots and charts);
    - Gate analysis (including plots and charts);
    - Density analysis;
    - Domain analysis; and
    - CCPA analysis.
- Preliminary hazard assessment (FSA style assessment of each possible scenario);
    - Consultation; and
        - Developers; and

        - Stakeholders.
    - Risk Assessment (including mitigation / risk control options).

2.8 Commercial Fisheries

The FTOWDG has commissioned Brown & May Marine Ltd to develop an assessment methodology that will inform the assessment of potential cumulative effects on commercial fisheries activity and interests.

The approach to assessment comprises the following:

- A regional assessment that will provide high level information of the current commercial fishing activity taking place in the region, including the principal fishing methods used, species targeted, fishing seasons and main fishing grounds. The assessment will provide data that can be used by each developer to support their project EIAs; and

- A standardised approach to site specific impact assessment agreed by all FTOWDG members. This would allow for the assessments of specific projects to be integrated and compared, and also enable cumulative assessments where the magnitude of the effects can be 'added up'.

2.8.1 Potential Effects

The potential effects of offshore wind farm developments on commercial fishing, as specified in the 'Offshore Wind Farms Guidance Note for Environmental Impact Assessment In respect of FEPA and CPA requirements' (Version 2-June 2004), are as follows:

- Complete loss or restricted access to traditional fishing grounds;
- Interference with fishing activities;
- Increased steaming times to fishing grounds;
- Sea bed Obstacles;
- Adverse effects on commercially exploited fish and shellfish populations (this will be assessed in the Natural Fish and Shellfish Resources component of the EIAs, its findings would be cross-referenced);
- Impact on recreational fish populations (this will be assessed in the Natural Fish and Shellfish Resources and Salmon and Sea Trout components of the EIAs. The findings would be cross-referenced);
- Safety issues for fishing vessels (this will largely be assessed in the Shipping and Navigation component of the EIAs and integrated in the Commercial Fishing component); and
- Any other concerns raised by local fishermen and fishing organisations.

2.8.2 Study Area

National and regional study areas are proposed and shown in **Figure F** below. The regional study area covers East coast STW sites and the Firth of Forth Round 3 Zone whilst the national study area includes all the STW and Scottish Round 3 Areas. Study area boundaries are aligned with ICES statistical rectangles.

The national scale study area is applied in order to reflect the relative importance of the regional area in terms of fishing. In addition, from a cumulative perspective, the collation of data at a national level would allow for potential cumulative effects at a national scale to be identified. Data analysis and interpretation will however be more exhaustive at the regional level.

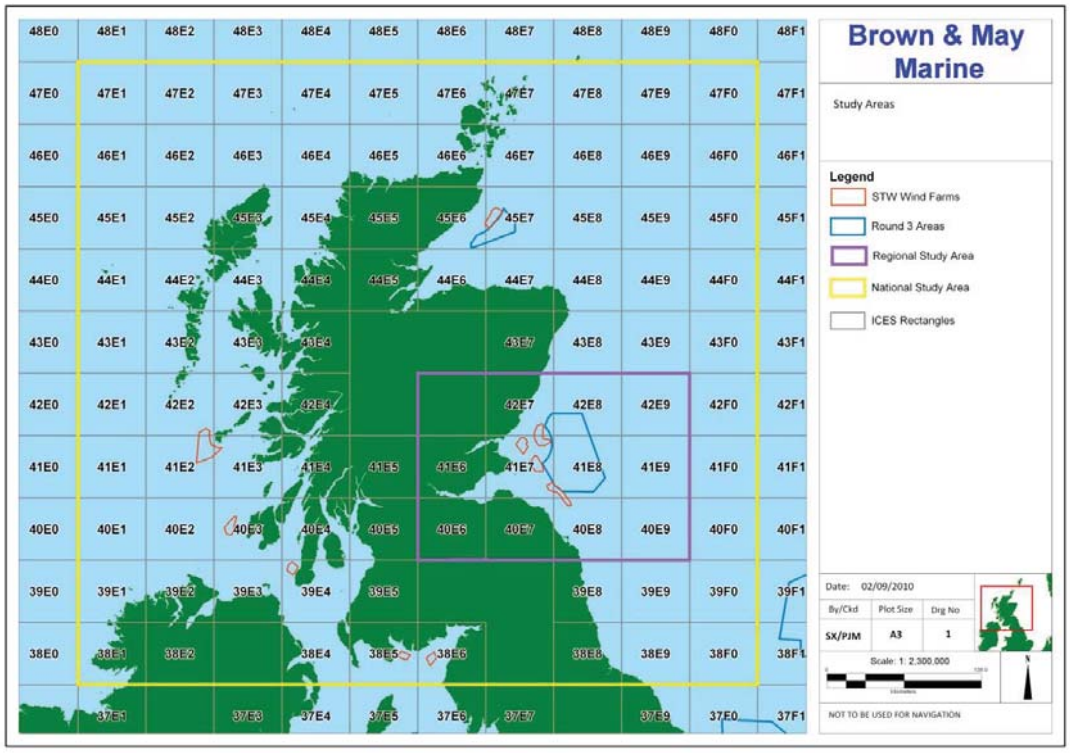


Figure F Commercial fisheries study areas

Question 20

Is the proposed Study Area appropriate? (If not, what alternative would you propose?).

2.8.3 Data Gathering

Whilst the assessment will be primarily based on desk-top information, consultation with key national and regional stakeholders will also be undertaken. Primary data sources are listed below.

Literature Review

- EC & UK and Local Fisheries Legislation;
- Marine Scotland Publications;
- Marine Scotland Science Publications;
- Inshore Fisheries Groups (IFGs) Publications;
- Oil & Gas UK Publications;
- ICES Stock Assessment Reports and other ICES publications of relevance;

- CEFAS Publications; and
- Any other relevant publications.

Marine Scotland Datasets

- Landings Values Data (2000-2009): Data for all UK vessels landings into all ports and non-UK vessels landings into UK ports;
- Effort Data (2000-2009): Data for all UK vessels landing into all ports and non-UK vessels landing into UK ports;
- Surveillance Sightings Data (2000-2009): Data for all vessels sighted by method and nationality; and
- VMS Data Position Plots (2005 to 2008/2009): Data for UK Over-15m vessels only.

Consultation

At this stage, individual fishermen will not be consulted as it is appreciated that the results of the regional assessment will help to identify potential issues and areas where local, individual fishermen consultation should specifically be targeted. Consultation will therefore focus on:

- Marine Scotland;
- Marine Scotland Science;
- Scottish Fishermen Federation (SFF);
- Fishing Industry Representatives (FIRs); and
- Inshore Fisheries Groups (IFGs)

Question 21

Are you aware of any additional data sources that should be considered in the assessment?

2.8.4 Data Analysis

Marine Scotland Landings Values and Effort Data

Marine Scotland landings values and effort will be analysed spatially (by ICES rectangle) to obtain information on the principal species targeted and methods used both at the national and regional level. This will be based on annual average landings values and effort.

An indication of the seasonality of the fisheries will be obtained based on average monthly landings values by species and effort by method.

Annual variations in the landings values and effort will also be analysed as well as the percentage of effort and landings values which different vessel categories (under 10m, 10-15m and over 15m vessels) account for by method.

The landings values and effort datasets will also be analysed to give an indication of the relative importance of fishing the regional area to different ports.

The results of the above analysis will be cross-referenced with the findings of the literature review and integrated with the information gathered through consultation.

Marine Scotland Surveillance Sightings Data

The spatial distribution of fishing by method and nationality will be assessed based on surveillance sightings plots (2000-2009).

Marine Scotland Satellite Tracking (VMS) Data

VMS data will be GIS plotted to show the density of UK over 15m vessels (average 2005-2008).

Information Gathered through Consultation

It is expected that the information obtained through the consultation process will provide an overview of the principal fishing methods potentially impacted by the wind farm developments and the location of the main fishing grounds by method. It will also help in identifying potential issues that may arise and specific areas/fleets with which intensive consultation will have to be carried out to assess potential effects both from a regional perspective and for project specific EIAs.

Standardised Assessment of Effects in EIA

Recommendation: The site specific impact assessments carried out for all the developments as part of their EIAs will, where possible (based on timing) be integrated to facilitate the undertaking of cumulative effects assessments by each developer. To enable such integration all developers within the group will be required to:

- Take a common, standardised approach to assessing effects in their EIAs; and
- Share project information and programmes as information becomes available.

Determination of significance of effects is an often contentious part of the EIA process, involving value judgements and personal interpretation about whether, and to what degree, a proposed project is environmentally significant. Brown & May Ltd therefore recommend that whilst developers individually consider potential cumulative effects within their EIAs, they each adhere to a standardised set of impact assessment criteria.

Question 22

Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).

2.8.5 Presentation of Results

Data resulting from the regional assessment will be made available to each FTOWDG member. Cumulative effects will be considered within the relevant chapters of the Environmental Statements produced for each development, using standardised impact assessment criteria which will be agreed by FTOWDG members and Marine Scotland, in consultation with SNH and the JNCC.

2.9 Seascape, Landscape and Visual Character

2.9.1 Potential Effects

Best practice guidelines identify three main types of potential cumulative visual effect:

- Simultaneous (or combined) visibility – where two or more sites are visible from a fixed viewpoint in the same arc of view;
- Successive visibility – where two or more sites are visible from a fixed viewpoint, but the observer is required to turn to see the different sites; and,
- Sequential visibility – where two or more sites are not visible at one location, but would be seen as the observer moves along a linear route, for example, a road or public right of way.

The potential cumulative effects of the wind farm, in combination with other developments, on landscape and seascape character should be considered. These will include:

- Indirect effects on designated landscapes;
- Direct and indirect effects on undesignated seascapes; and,
- Indirect effects on undesignated landscapes.

The cumulative effects of the wind farm on visual resources should include consideration of potential effects on the following:

- Views from designated landscapes;
- Views from publicly accessible historic environment features;
- Views from Core Paths;
- Views from other promoted paths;
- Views from other public rights of way;
- Views from other publicly accessible land;
- Views from residential properties; and,
- Potential marine-based views.

Potential changes within the settings of designated and undesignated heritage assets during construction, operation and decommissioning of the wind farm should be considered, along with potential effects on the overall historic landscape.

2.9.2 Study Area

Given the probable height of the proposed offshore turbines (in excess of 160m to blade tip) and as requested by SNH the study area for the seascape and visual impact assessment of each individual offshore wind farm will be 50km from the boundary of each proposed offshore wind farm.

The cumulative assessment will consider existing and consented wind farms and may include other major planning proposals within an agreed distance of the boundaries of the proposed site, that have formally entered the planning system through submission of a scoping report and scoping response from the local authority or full planning application. The list of projects to be considered is to be agreed with the relevant authorities, including SNH.

The search area for cumulative schemes will be 85km. This includes the 50km study area of the offshore wind farm(s) and, should any onshore wind farms be identified in this search area, a ZTV will be generated to an appropriate radius, e.g. for cumulative schemes with turbines over 100m this will be a 35km radius. Where the ZTV of the cumulative scheme overlaps that of the offshore wind farm (within the 50km study area) there is the potential for cumulative effects.

A list of preliminary cumulative viewpoints has been generated. This list is subject to agreement between FTOWDG, relevant local authorities and statutory consultees (see **Figures I and J**).

Question 23

Is the proposed Study Area appropriate? (If not, what alternative would you propose?).

2.9.3 Data Gathering

The discipline of seascape and visual impact assessment (SVIA) has evolved over a number of years. Current SVIA methodology in the UK is founded on guidance and techniques published by the Landscape Institute and the Institute of Environmental Management and Assessment, the Countryside Agency and Scottish Natural Heritage and the Countryside Commission for Wales, Brady Shipman Martin and University College Dublin.

The SVIA will be undertaken with reference to best practice outlined in published guidance:

- Guidelines for Landscape and Visual Impact Assessment, Second Edition (2002) Landscape Institute and the Institute for Environmental Management and Assessment;
- Landscape Character Assessment: Guidance for England and Scotland (2002) Countryside Agency and Scottish Natural Heritage; and,
- Guide to best Practice in Seascape Assessment (2001) Countryside Council for Wales, Brady Shipman Martin, University College Dublin, Maritime Ireland / Wales INTERREG Report No. 5.

There is also a range of published best practice guidance specifically for the assessment of effects of proposed wind farms. Guidance in the following documents (amongst others) will be referred to:

- Guidance on the Assessment of the Impact of Offshore Wind Farms: Seascape and Visual Impact Report (November 2005) Enviros, for the DTI;
- Visual Assessment of Wind Farms – Best Practice (2002) University of Newcastle, Scottish Natural Heritage commissioned report F01AA303A;
- Guidance on Cumulative Effect of Windfarms, Version 2 (revised April 2005) Scottish Natural Heritage;
- Visual Representation of Windfarms: Good Practice Guidance (dated 2006, published 2007) Scottish Natural Heritage;
- Draft Planning Standards and Requirements for the Preparation and Submission of Photographs and Photomontages to illustrate the impacts of Wind Energy Development for inclusion in Planning Applications and Environmental Statements. Highland Council (2009); and
- COWRIE (Oxford Archaeology, 2008) Guidance for Assessments of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy;

- Scottish Natural Heritage, An Assessment of the Sensitivity and Capacity of the Scottish Seascape in Relation to Windfarms, Scottish Natural Heritage commissioned report 103, 2005.

The approach to data gathering will be as follows:

- Assessment of other major projects to be included within the study;
- Landscape character descriptions (e.g. Scott et al. 2005);
- Seascape unit/area identification (e.g. Scott et al. 2005);
- Photomontage or wireframe representations;
- Assessment of meteorological data for visibility for the past 10 years;
- Assessment of sea use/users; and,
- Field work to confirm desk-based study and for descriptions of chosen viewpoints.

Data required to inform the study would include the following:

- Assessment of other major projects to be included within the study;
- Landscape character descriptions (e.g. Scott et al. 2005);
- Seascape unit/area identification (e.g. Scott et al. 2005);
- Locations and descriptions of designated and undesignated heritage assets;
- Historic Landscape Characterisation data;
- Historic Seascape Characterisation data;
- Photomontage or wireframe representations;
- Assessment of meteorological data for visibility for the past 10 years;
- Assessment of sea use/users; and
- Field work to confirm desk-based study and for descriptions of chosen viewpoints.

Additional Considerations

SNH has suggested a 50km radius study area to reflect the scale of the proposed 160m (and over) high turbines, rather than a previously accepted 35km radius. This provides a starting point for the SVIA process. However, in addition to turbine height, two further factors should also be considered to reflect the likely significant landscape, seascape and visual effects within an established study area. These include;

- Curvature of the earth
- Acuity of the eye

Curvature of the Earth

When the proposed wind farm is viewed from locations near sea level, turbines at distances greater than 50km would disappear over the horizon (see figure 1). Only the turbine blades would theoretically be visible at distances of between 40 and 45km.

These distances could theoretically be exceeded for land based receptors. The presence of the Grampian Mountains in the north of the study area provides viewing locations for sensitive receptors. The angle of view gained by receptors at this elevation would, to some degree, counteract the curvature of the earth, extending the potential availability of views of the wind farms.

Acuity of the Eye

The Guide to Best Practice in Seascape Assessment (GSA) discusses the limitations of the acuity of the human eye. The guidance states that: "*At a distance of 1 kilometre in conditions of good visibility a pole of 100mm diameter will become difficult to see, and at 2 kilometres a pole of 200mm diameter will similarly be difficult to see. In other words there will be a point where an object, whilst still theoretically visible, will become too small for the human eye to resolve. Mist, haze or other atmospheric conditions may significantly exacerbate that difficulty.*" Consequently, when visible in favourable conditions, a slim object approximately 3m in width (such as a wind turbine blade) will be at the limit of perception by the human eye at a distance of 30km.

An object would need to be greater than 5m wide to be visible at or beyond 50km. Only the nacelle and not the blades would be large enough to be visible at this distance, however the nacelle would be below the horizon when viewed from near sea level.

A combination of curvature of the earth and acuity of the eye would limit the potential for significant seascape, landscape and visual effects. Detailed analysis of the local landscape and seascape and the identification of visual receptors should be undertaken to enable an assessment of the particular effects associated with the proposed development to be established. However, the likelihood of considerable significant effects in the suggested additional zone of the study area (50km rather than 35km) is limited.

Question 24

Are you aware of any additional data sources that should be considered in the assessment?

2.9.4 Data Analysis

Recommendation: Potential cumulative effects of wind farms will be assessed by considering the degree of overlap between the Zone of Theoretical Visibility (ZTV) of the proposed wind farm developments. Photomontages may also be used to illustrate selected viewpoints if two or more wind farms are likely to be visible. The significance of cumulative effects will be established by cross-referencing the sensitivity of viewpoints where more than one site would be visible and the cumulative magnitude of effect on each particular view. See **Appendix F** for detail on these methods of analysis.

The geographical extent of potential visibility will be established for turbine hub and blade-tip heights through the production of a ZTV plan for the wind farms.

Due to the extent of the ZTV, it would be impossible to assess the visual impact on every individual visual receptor identified within the ZTV. Consequently, key viewpoints looking towards the proposals will be agreed with consultees as part of the baseline assessment (see indicative ZTVs in **Figures G** and **H**). The viewpoints will be representative of potentially sensitive receptors situated within the study area at varying distances and directions. These representative viewpoints will be used to assess the potential visual effects of the proposals on the different range of views towards the site.

Wireline diagrams of the proposals will be produced and set alongside baseline photographs of the landscape to illustrate the location and potential appearance of the wind turbines from each of

the agreed viewpoints. A number will be developed further into photomontages of the proposed development.

Table Q Summary of seascape and landscape methods and activities agreed between developers.

Method/Activity	Status
SVIA	Commissioned by FTOWDG to cover whole study area
Data gathering and analysis	Undertaken on behalf of all FTOWDG members

Question 25

Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).

2.9.5 Presentation of Results

The significance of impact will be based upon guidance from *Guidelines for Landscape and Visual Impact Assessment*': Second Edition – The Landscape Institute and Institute of Environmental Management and Assessment (2002).

Significance criteria to be used in the cumulative effects assessments are yet to be determined and agreed by developers.

The following table provides potential significance criteria for landscape/seascape and visual effects. All significance criteria are subject to the agreement of FTOWDG.

Table R Potential Significance Criteria

Significance of Effect	Landscape Resource	Visual Resource / Amenity
Major	Where the proposed changes would be uncharacteristic and/or would significantly alter a valued aspect of (or a high quality) landscape	Where the proposed changes would be uncharacteristic and/or would significantly alter a valued view or a view of high scenic quality
Moderate	Where proposed changes would be noticeably out of scale or at odds with the character of an area	Where proposed changes to views would be noticeably out of scale or at odds with the existing view
Minor	Where proposed changes would be at slight variance with the character of an area	Where proposed changes to views, although discernible, would only be at slight variance with the existing view
Negligible	Where proposed changes would have an indiscernible effect on the character of an area	Where proposed changes would have a barely noticeable effect on views / visual amenity
None	Where proposals would be in keeping with the landscape character of the area and/or would maintain landscape quality, or where the benefits of proposed mitigation would balance adverse impacts	Where proposals would retain existing views, or where on balance the proposed mitigation would maintain the quality of views (i.e. adverse impacts are balanced by

Significance of Effect	Landscape Resource	Visual Resource / Amenity
		beneficial effects).

Figure G Indicative Zone of Theoretical Visibility – northern extent.

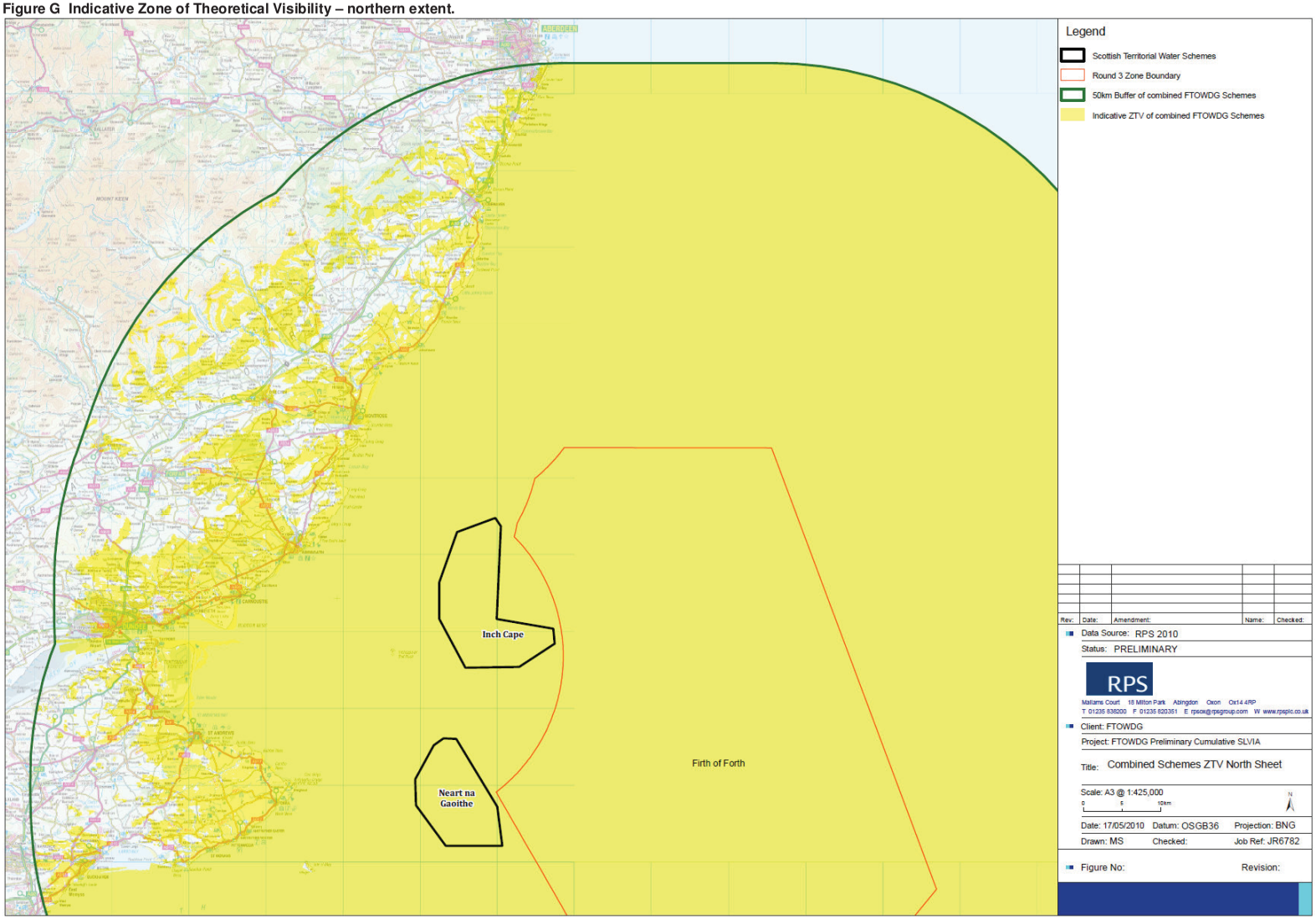


Figure H Indicative Zone of Theoretical Visibility – southern extent.

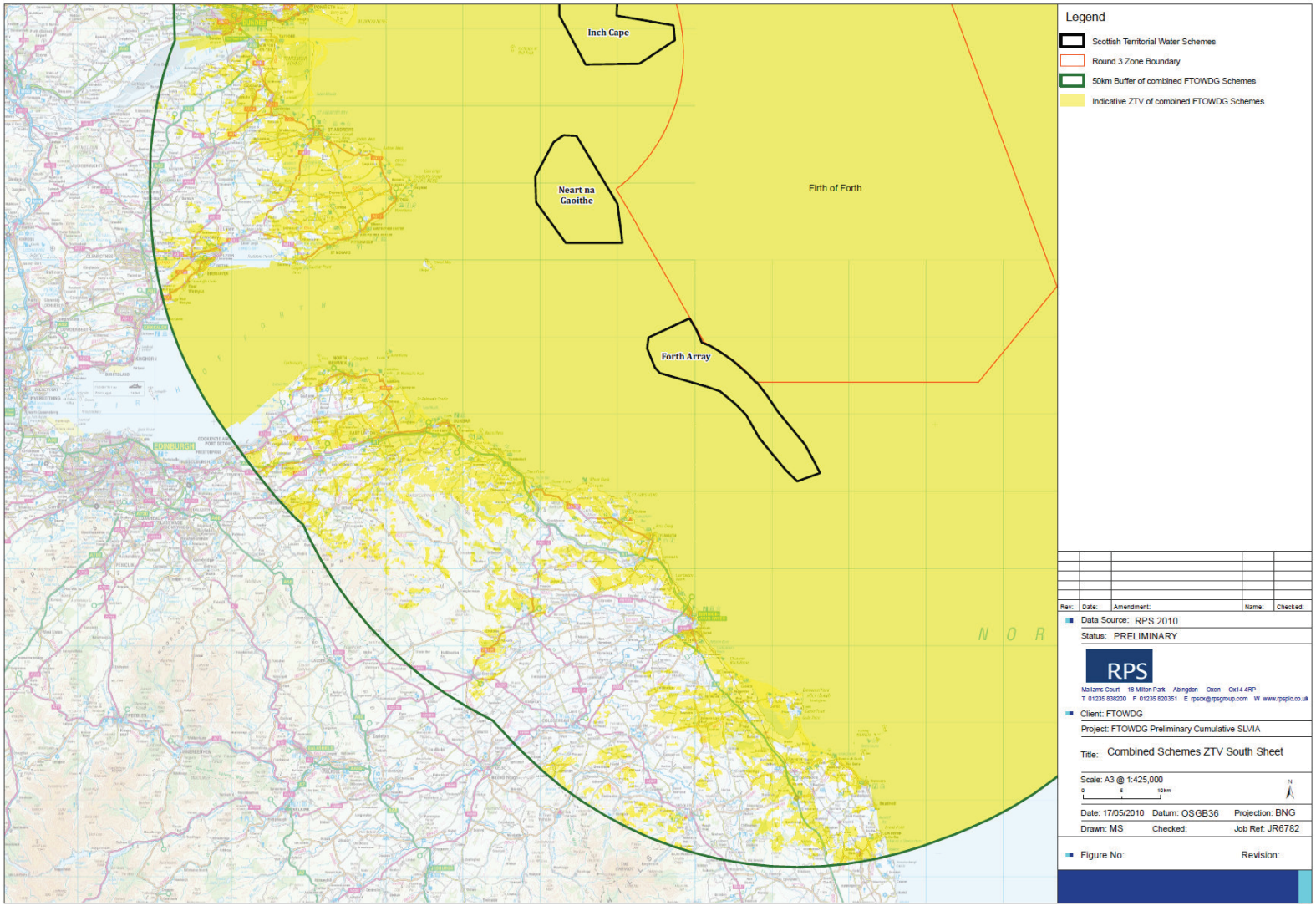
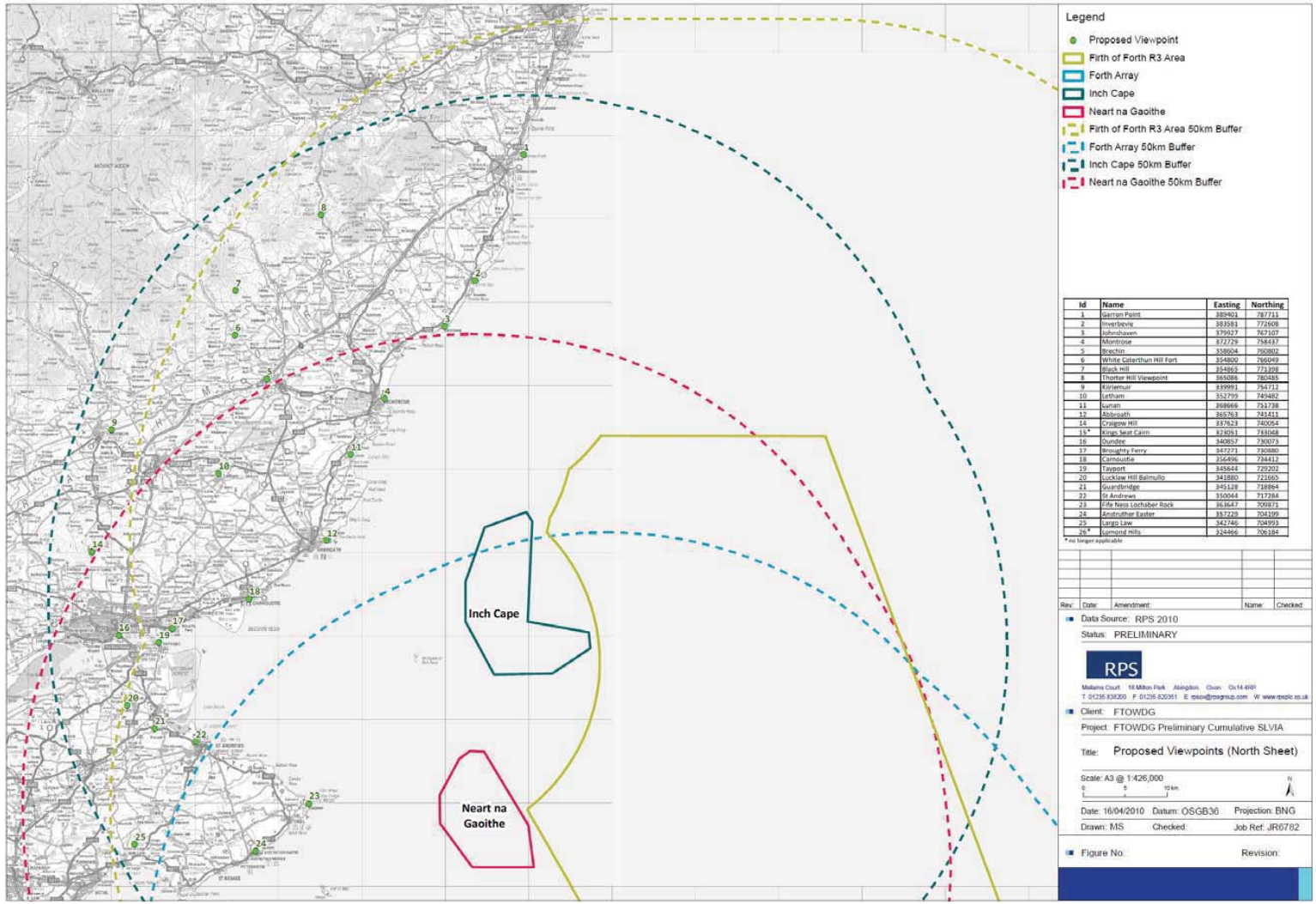


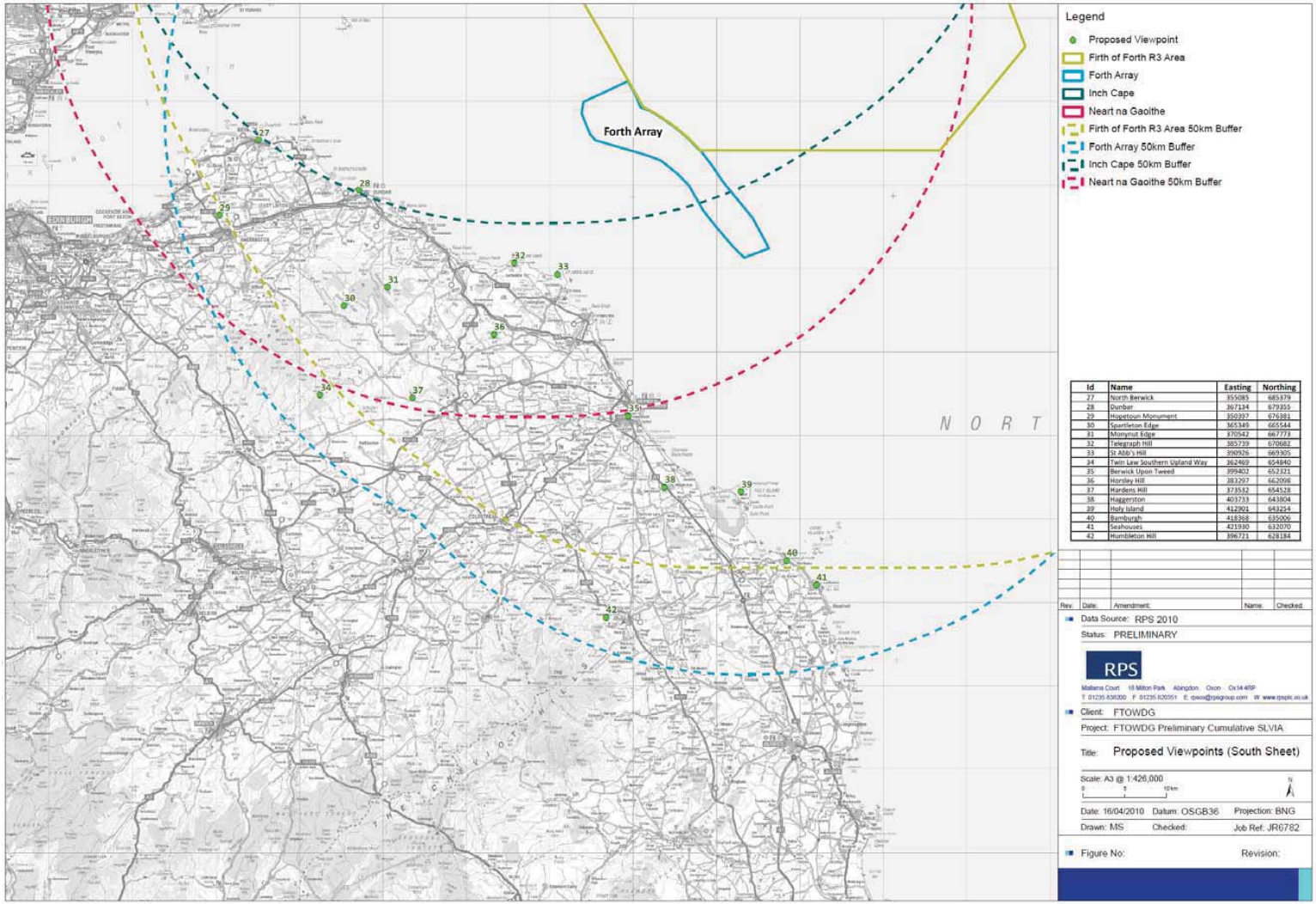
Figure I Preliminary cumulative viewpoints – northern extent



Id	Name	Easting	Northing
1	Garron Point	389401	787711
2	Inverbervie	383581	772608
3	Johnshaven	379927	767107
4	Montrose	372729	758437
5	Brechin	358604	760802
6	White Caterthun Hill Fort	354800	766049
7	Black Hill	354865	771298
8	Thorter Hill Viewpoint	365086	780485
9	Kirriemuir	339991	754712
10	Letham	352799	749482
11	Lunan	368666	751738
12	Abbroath	365763	741411
14	Craigow Hill	337623	740054
15*	Kings Seat Cairn	823051	733068
16	Dundee	340857	730075
17	Broughty Ferry	347271	730880
18	Carnbustie	356496	734412
19	Tayport	345644	729202
20	Lucklaw Hill Balmullo	341880	721665
21	Guardbridge	345128	718864
22	St Andrews	350044	717284
23	Fife Ness Lochaber Rock	363647	709871
24	Anstruther Easter	357229	704199
25	Largo Law	342746	704993
26*	Lomond Hills	324466	706184

* no longer applicable

Figure J Preliminary cumulative viewpoints – southern extent



2.10 Marine Archaeology and Cultural Heritage

The potential for the proposed Forth and Tay offshore wind farm developments to have cumulative effects on marine archaeology and cultural heritage assets will be established by each of the individual developers within respective EIA's. Proposed methodologies are outlined in developer's Scoping documents and will be agreed with SNH, Historic Scotland and other relevant stakeholders.

As outlined in the Seascape, Landscape and Visual Character assessment above, cumulative effects on designated heritage assets will be included by each of the developers within their assessments.

2.11 Socio-economics, Recreation and Tourism

The potential for the proposed Forth and Tay offshore wind farm developments to have cumulative effects on local, regional and national socio-economics and recreation and tourism receptors will be established by each of the individual developers within respective EIA's. Proposed methodologies are outlined in developer's Scoping documents and will be agreed with relevant stakeholders.

3 SUMMARY & CONSULTATION

This Discussion Document details how FTOWDG members propose to assess the potential cumulative and in-combination effects that may arise as a result of the development of their offshore wind farm sites.

Table S below summarises the approach taken by FTOWDG members to addressing key cumulative effects (e.g. data sharing, use of standardised methods). Where known, it details when assessments or surveys will be undertaken, and what outputs stakeholders can expect to be produced. Where there will be no FTOWDG collaborative technical report produced, it can be assumed that cumulative effects will be addressed within the ES produced for each wind farm project.

Table S Cumulative Studies – Approaches, Outputs and Timings

Topic	Forth Array	Inch Cape	Neart na Gaoithe	Round 3 Zone 2		
				Phase 1	Phase 2	Phase 3
	Cumulative Assessment Approach / Outputs					
Hydrodynamic Processes and Geomorphology	• Regional STW Technical Report • Standardised survey methods			• Zone Technical Report (Q4 2011) • Standardised survey methods		
Marine Mammals	• FTOWDG Technical Report (Q2 2011) • FTOWDG underwater noise study • Sharing processed boat-based survey data (Sept 2011) • Standardised methods					

Topic	Forth Array	Inch Cape	Neart na Gaoithe	Round 3 Zone 2		
				Phase 1	Phase 2	Phase 3
	Cumulative Assessment Approach / Outputs					
Benthic Ecology	• No FTOWDG Technical Report • Standardised methods					
Natural Fishery Resources	• FTOWDG Technical Report • Share survey data • Standardised survey and assessment methods					
Ornithology	• FTOWDG technical report (Q2 2011) • Sharing processed boat-based survey data (Sept 2011) • Standardised methods[7]					
Designated Sites	• No FTOWDG Technical Report					
Shipping and Navigation	• Regional assessment (Q1 2011) • Regional baseline data gathering (ongoing) • Standardised methods					
Commercial Fisheries	• No FTOWDG Technical Report • Regional baseline data gathering (ongoing) • Standardised methods					
Seascape, Landscape and Visual Character	• No FTOWDG Technical Report • Standardised methods					

The FTOWDG now seek advice and comment on their proposed approaches, and at this time wish to undertake targeted consultation on this Discussion Document with those organisations listed in **Table T**. A consultee response template is provided at the end of this document.

Table T Discussion Document 2 Consultees

Marine Scotland	Dundee City Council
Scottish Natural Heritage	Royal Society for the Protection of Birds Scotland
Joint Nature Conservation Committee	British Trust for Ornithology
Natural England	Scottish Fishermen's Federation
Northern Lighthouse Board	Chamber of Shipping
Maritime and Coastguard Agency	Ministry of Defence / Defence Estates
Historic Scotland	National Air Traffic Services
East Lothian Council	Civil Aviation Authority
Fife Council	Highlands and Islands Airports Ltd
Angus Council	Scottish Inshore Fishery Groups
Forth Ports	Health and Safety Executive
Scottish Environment Protection Agency	Department for Energy and Climate Change

[7] Methods adapted from ESAS and COWRIE guidelines (Camphuysen et al 2004; Maclean et al 2009).

4 REFERENCES

AMEC. 2009. Cumulative Study Report – Ornithology (Bell Rock, Forth Array, Inch Cape and Neart na Gaoithe.

CEFAS. 2004. Offshore wind farms: Guidance note for Environmental Impact Assessment In respect of FEPA and CPA requirements. CEFAS. V2. June 2004.

Connor, D.W, Allen, J.H, Golding, N, Howell, L, Lieberknecht, L.M, Northern, K.O and Reker, J.B. 2004. he Marine Habitat Classification for Britain and Ireland Version 04.05 JNCC, Peterborough.

Countryside Agency and Scottish Natural Heritage. 2002. Landscape Character Assessment: Guidance for England and Scotland.

Countryside Council for Wales, Brady Shipman Martin, University College Dublin, Maritime Ireland / Wales INTERREG. 2001. Guide to best Practice in Seascape Assessment Report No. 5.

Daunt, F., Wanless, S., Greenstreet, S.P.R., Jensen, H., Hamer, K.C. & Harris, M.P. 2008. The impact of sandeel fishery closure in the northwestern North Sea on seabird food consumption, distribution and productivity. Canadian Journal of Fisheries and Aquatic Sciences, 65, 362-381.

DECC (2009). A Prevailing Wind: Advancing UK Offshore Wind Deployment.

Diederichs, A., G. Nehls, M. Dähne, S. Adler, S. Koschinski, U. Verfuß. 2008. Methodologies for measuring and assessing potential changes in marine mammal behaviour, abundance or distribution arising from the construction, operation and decommissioning of offshore windfarms. BioConsult SH report to COWRIE Ltd.

DTI. Guidance on the Assessment of the Impact of Offshore Wind Farms: Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms. Department for Trade and Industry, 2005.

Enviros. 2005. Guidance on the Assessment of the Impact of Offshore Wind Farms: Seascape and Visual Impact Report. DTI.

Fujii, Y. and Tanaka, K. “Traffic Capacity.” The Journal of Navigation 24 (1971): 543-552.

Garthe, S. and Huppop, O. 2004. Scaling possible adverse effects of marine windfarms on seabirds: developing and applying a vulnerability index. J. Appl. Ecol. 41. 724-734.

Goodwin, E. M. “A statistical study of ship domains.” The Journal of Navigation 28 (1975): 329-341.

Griffin L., Rees, E., Hughes, B. (2010). *The migration of whooper swans in relation to offshore wind farms*. WWT Final Report to COWRIE Ltd., WWT Slimbridge. 69 pp.

Highland Council. 2008. Draft Planning Standards and Requirements for the Preparation and Submission of Photographs and Photomontages to illustrate the impacts of Wind Energy Development for inclusion in Planning Applications and Environmental Statements.

HR Wallingford. 2009. Firth of Forth and Tay Developers Group, Collaborative Oceanographic Survey, Specification and Design. TM DER4359-01.

JNCC. 2010. The protection of marine European Protected Species from injury and disturbance. Accessed at: http://www.jncc.gov.uk/page-4226

King, S., Maclean, I.M.D., Norman, T., and Prior, A. (2009) Developing Guidance on Ornithological Cumulative Impact Assessment for Offshore Wind Farm Developers. COWRIE.

Landscape Institute and the Institute for Environmental Management and Assessment. 2002. Guidelines for Landscape and Visual Impact Assessment, Second Edition.

Langston, R. (2010) Offshore Wind Farms and Birds. RSPB Report No. 39, RSPB, Sandy, UK. 40 pp.

MARICO Marine. Investigation of Technical and Operational Effects on Marine RADAR Close to Offshore Wind Farms. British Wind Energy Association, 2006.

MARICO Marine. Traffic Surveys. East Coast Traffic Routing. Consultation Draft prepared for the Maritime and Coastguard Agency. Southampton: MARICO Marine, 2004.

MARICO Marine. Vessel Traffic Analysis from AIS data for Forth Offshore Wind Farms. Southampton: MARICO Marine, 2009.

Masden, E.A., Haydon, D.T., Fox, A.D., Furness, R.W., Bullman, R., Desholm, M. (2009). Barriers to movement: impacts of wind farms on migrating birds. *ICES Journal of Marine Science,* 66: 746–753.

Masden, E.A., Haydon, D.T., Fox, A.D., Furness, R.W., (In press). Barriers to movement: Modelling energetic costs of avoiding marine wind farms amongst breeding seabirds. *Marine Pollution Bulletin*

Matthiopoulos, J., McConnell, B., Duck, C. & Fedak, M. 2004. Using satellite telemetry and aerial counts to estimate space use by grey seals around the British Isles. J. Appl. Ecol. 41, 476-491.

MCA MGN371. Marine Guidance Note 371 (M+F) Offshore Renewable Energy Installations (OREIs) - Guidance on UK Navigational Practise, Safety and Emergency Response. Southampton, UK: Maritime and Coastguard Agency.

Nedwell, J., Turnpenny, A.W.H., Lovell, J., Parvin, S.J., Workman, R., Spinks, J.A.L. and Howell, D. (2007). A validation of the dBht as a measure of the behavioural and auditory effects of underwater noise. Subacoustech, 534 R 1231.

Nehls, G., K. Betke, S. Koschinski, and K. Lüdemann (2008). Sources of underwater noise and their implications on marine wildlife - with special emphasis on the North Sea and the Baltic Sea.

UBA FKZ 206 25 2021. German Federal Environment Agency (Umweltbundesamt - UBA). Dessau, Germany. 126 pp.

Oxford Archaeology. 2008. Guidance for Assessments of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy. COWRIE.

Reid, J.B., Evans, P.G.H., & Northridge, S.P., (2003), Atlas of Cetacean distribution in north-west European waters

Royal Haskoning. 2009. Scottish Territorial Windfarms: Cumulative Effects Assessment – Forth and Tay Estuaries.

Scott, K.E., Anderson, C., Dunsford, H., Benson, J.F. and MacFarlane, R. 2005. An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms. Scottish Natural Heritage Commissioned Report No.103 (ROAME No. F03AA06).

Scottish Natural Heritage. 2005. Guidance on Cumulative Effect of Windfarms, Version 2 (revised April 2005).

Scottish Natural Heritage. 2007. Visual Representation of Windfarms: Good Practice Guidance (dated 2006, published 2007).

Scottish Natural Heritage. 2010. Use of Avoidance Rates in the SNH Wind Farm Collision Risk Model http://www.snh.gov.uk/docs/B721137.pdf

Southall, B.L., Southall, A., Bowles., E, Ellison., Finneran, J., Gentry, R., Greene, R., Kastak., ., Ketten, D., Miller, J., Nachtigall, P., Richardson, J., Thomas, A., and Tyack., P. (2007) Marine mammal noise exposure criteria. Aquatic Mammals. 33 (4).

Speakman, J., Gray, H., and Furness, L., (2009) Effects Of Offshore Wind Farms On The Energy Demands Of Seabirds. DECC.

University of Newcastle. Visual Assessment of Wind Farms – Best Practice (2002), Scottish Natural Heritage commissioned report F01AA303A.

Vanermen, N. And Stienen, S.T.W. Seabirds and Offshore Wind Farms: Monitoring Results 2008. Rapport INBO.R.2009.8. March 2009. INBO, Brussels. 105 pp.

Wang, Ning, Xianyao Meng, Qingyang Xu, and Zuwen Wang. “A Unified Analytical Framework for Ship Domains.” The Journal of Navigation (Royal Institute of Navigation), 2009: 643-65

Consultee Response Template

We would be pleased to receive your views on this Discussion Document. In particular we are interested in your responses to the questions below, but would also welcome any additional comments you may have.

Please complete the template below and return your response by 10th January 2011 to:

Forth and Tay Offshore Wind Developers Group, care of:
Sarah Wright, Royal Haskoning, 69 Buchanan Street, Glasgow G1 3HL
Email: s.wright@royalhaskoning.com (Tel: 0141 314 3777)

Hydrodynamic Processes and Geomorphology

Question 1
Is the proposed Study Area appropriate? (If not, what alternative would you propose?).
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Question 2
Are you aware of any additional data sources that should be considered in the assessment?
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Question 3
Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).
……
……

Benthic Ecology

Question 4
Is the proposed Study Area appropriate? (If not, what alternative would you propose?).
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Question 5
Are you aware of any additional data sources that should be considered in the assessment?
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Question 6
Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).
……
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Ornithology

Question 7
Are you aware of any additional data sources that should be considered in the assessment?
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Question 8
With cost in mind, is there any one particular migratory species for which additional data is considered essential? If so, which species?
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Question 9
Are there any obvious candidates for population modeling at this stage? If so, which species?
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Question 10
It is understood that SNH/JNCC are reviewing the COWRIE guidance and approaches to cumulative assessment in Rounds 1 and 2 development in England and Wales and at other European wind farm sites. Does this review suggest that methods other that the proposed analyses should be used?
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Marine Mammals

Question 11
Is the proposed Study Area appropriate? (If not, what alternative would you propose?).
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Question 12
Are you aware of any additional data sources that should be considered in the assessment?
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Question 13
Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).
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Natural Fishery Resources

Question 14
Is the proposed Study Area appropriate? (If not, what alternative would you propose?).
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Question 15
Are you aware of any additional data sources that should be considered in the assessment?
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Question 16
Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).
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Shipping and Navigation

Question 17
Is the proposed Study Area appropriate? (If not, what alternative would you propose?).
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Question 18
Are you aware of any additional data sources that should be considered in the assessment?
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Question 19
Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).
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Commercial Fisheries

Question 20
Is the proposed Study Area appropriate? (If not, what alternative would you propose?).
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Question 21
Are you aware of any additional data sources that should be considered in the assessment?
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Question 22
Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).
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Seascape, Landscape and Visual Character

Question 23
Is the proposed Study Area appropriate? (If not, what alternative would you propose?).
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Question 24
Are you aware of any additional data sources that should be considered in the assessment?
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Question 25
Are the proposed analysis methods suitable? (If not, what alternative would you suggest?).
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Any other comments

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