Navigational Risk Assessment Phase 1 Offshore Wind Farms Project Alpha and Project Bravo (Technical Note)

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 *Background*

Anatec was commissioned by Seagreen Wind Energy Limited (Seagreen) to perform a shipping and navigation assessment of the proposed Alpha and Bravo offshore wind farms ('Project Alpha' and 'Project Bravo') located in the Firth of Forth Round 3 Zone 2 Phase 1 development, located in the outer approaches to the Firth of Forth and Firth of Tay.

The report presents information on Project Alpha and Project Bravo relative to the baseline navigational activity and features for the area. Following this, an assessment of the risk from the proposed sites on navigation is presented.

The Export Cable Route (ECR) baseline navigational activity and a qualitative assessment of the potential risks to navigation can be found in Appendix A.

1.2 *Scope of the Assessment and Methodology*

The assessment methodology principally followed the Department of Energy and Climate Change (DECC) Risk Assessment Methodology (Ref. i) and the Maritime and Coastguard Agency's (MCA) Marine Guidance Note 371 (MGN 371) (Ref. ii).

An overview of the general methodology applied in the assessment is presented in Figure 1.1. (More information on the regulations and guidance being addressed is presented in Section 2.)

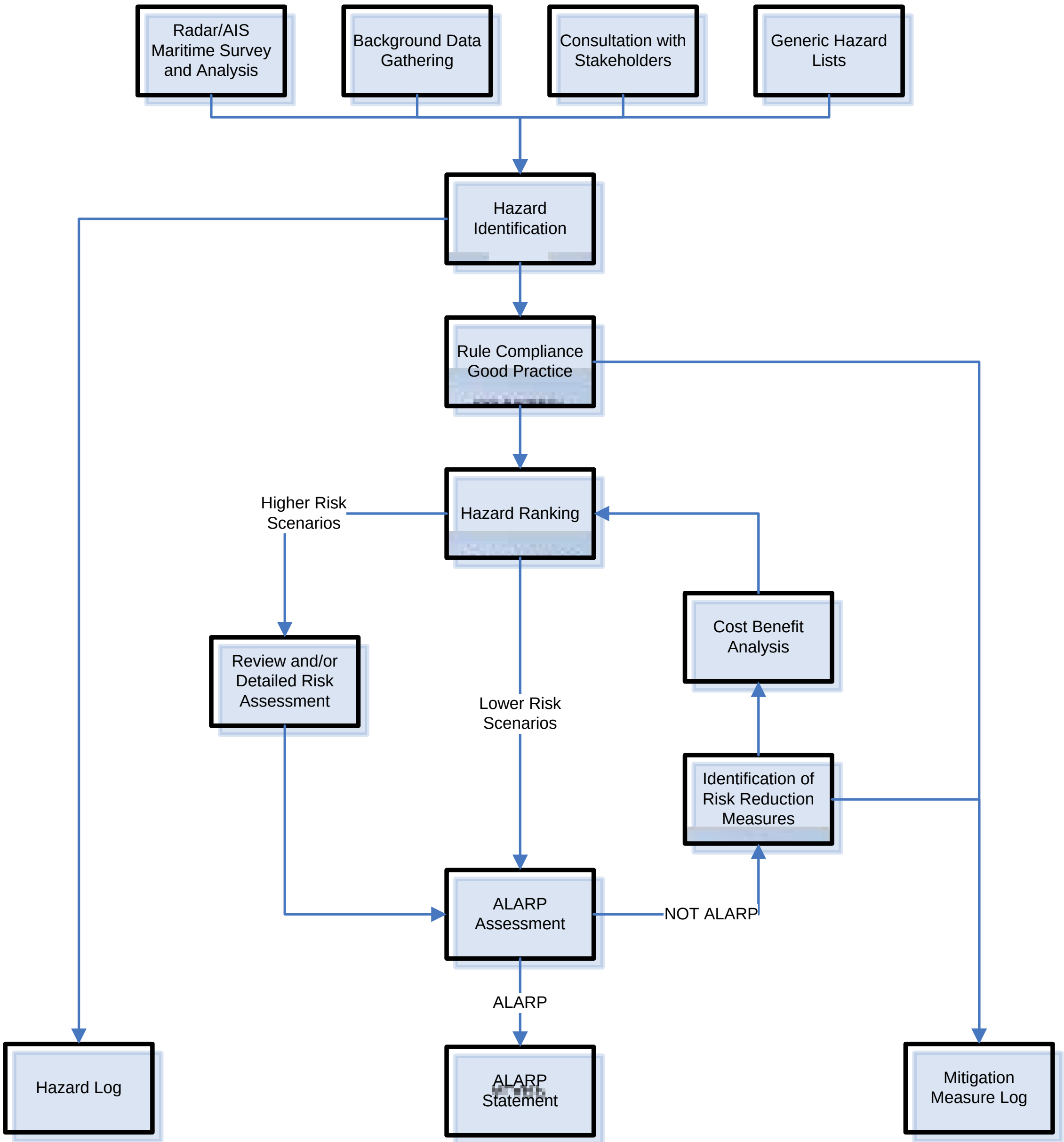

Figure 1.1 Overview of Methodology for Navigation Assessment

The main part of the assessment considers the risks associated with the presence of surface structures associated with the operational stage of the wind farms on the following maritime activities:

- Commercial shipping;
- Fishing; and
- Recreational sailing.

In addition to these activities, consideration is given to the following:

- Risks to marine radar;
- Risks associated with subsea array and export cables (the risks associated with the export cable are described in detail in Appendix A);
- Risks associated with construction/decommissioning stages; and
- Cumulative effect of other nearby developments.

1.3 *Methodology for Assessing Cumulative Effects*

The assessment of cumulative and in-combination effects includes considering the impacts arising from multiple offshore wind farm development activities and other (i.e. non-offshore renewable energy installation (OREI)) marine developments within the United Kingdom (UK) North Sea and outer Firth of Forth region.

The following subsections review the methodology used for assessing the cumulative effect of the Phase 1 offshore wind farms.

1.3.1 Assessment of Project Boundaries

Zone, site and project boundaries have been used for the cumulative and in-combination assessment. These boundaries are current as of July 2012. For the cumulative assessment, it is assumed that Neart na Gaoithe, Inch Cape and the Firth of Forth Phase 1 offshore wind farms (Project Alpha and Project Bravo) will be filled to full site capacity. A variation of the 'full capacity' layout for the Phase 1 wind farms will also be considered which does not contain any Wind Turbine Generators (WTGs) along the boundary between the Project Alpha and Project Bravo sites.

It should be noted that the identification of these boundaries at this stage, and their use within the assessment, does not exclude the potential for any site modifications or future developments within the Firth of Forth Phase 2 and Phase 3 areas. Phases 2 and 3 will not be assessed at this stage due to the data gaps, further work required and the magnitude of the design assumptions.

Other offshore wind farms such as the Beatrice and Moray Firth offshore wind farms and the European Offshore Wind Deployment Centre (EOWDC) at Aberdeen Bay have not been considered in the cumulative assessment due to their distance from Project Alpha and Project Bravo.

The assessment assumes industry standard mitigation measures as per MGN 371 (Ref. ii), International Association of Marine Aids to Navigation and Lighthouses (IALA) O-139, (Ref. iii) and any specific consent conditions that will be put in place within the developments.

1.3.2 Regional Approach

Cumulative issues are also being addressed as part of the Forth and Tay Offshore Wind Developers Group (FTOWDG) collaborative work. The Crown Estate formed FTOWDG to collaboratively identify potential cumulative effects of multiple wind farm developments.

The FTOWDG comprises of:

- Seagreen - Firth of Forth Round 3 Zone 2 developments offshore (outwith 12 nautical miles (nm));
- Mainstream Renewable Power - Neart na Gaoithe Scottish Territorial Waters (STW) inshore wind farm; and
- Repsol Nuevas Energías UK - Inch Cape STW inshore wind farm.

The regional report was commissioned by the FTOWDG (Ref. iv) to review the shipping and navigational aspects of the proposals on a regional level. This ensured that the individual developments are carried out in a coherent manner and cumulative issues relating to shipping and navigation are considered.

From the Regional Cumulative Shipping and Navigation review, the potential impacts on navigation from the regional developments (for both vessels transiting through the developments, and those vessels transiting in close proximity to sites) were assessed.

1.4 *Abbreviations*

The following abbreviations are used in this report:

AIS	-	Automatic Identification System
ALARP	-	As Low as Reasonably Practicable
ALB	-	All-Weather Lifeboat
ARPA	-	Automatic Radar Plotting Aid
AtoN	-	Aid to Navigation
BBC		British Broadcasting Corporation
BERR	-	Department for Business Enterprise & Regulatory Reform (now Department for Business, Innovation and Skills)
BWEA	-	British Wind Energy Association (now RenewableUK)
CA	-	Cruising Association
CAA	-	Civil Aviation Authority
CAST	-	Coastguard Agreement on Salvage and Towage
CCTV	-	Closed-circuit Television
COLREGS	-	International Regulations for Preventing Collisions at Sea
CoS	-	Chamber of Shipping
CNIS	-	Channel Navigation Information Service

dB	-	Decibels
DECC	-	Department of Energy and Climate Change
DfT	-	Department for Transport
DGPS	-	Differential Global Positioning System
DSC	-	Digital Selective Calling
DWT	-	Dead Weight Tonnes
EC	-	European Commission
ECR	-	Export Cable Route
EIA	-	Environmental Impact Assessment
EOWDC	-	European Offshore Wind Deployment Centre
ERCoP	-	Emergency Response Cooperation Plan
ES	-	Environmental Statement
ETV	-	Emergency Towing Vessel
EU	-	European Union
FPSO	-	Floating Production, Storage and Offloading Unit
FSA	-	Formal Safety Assessment
FTOWDG	-	Forth and Tay Offshore Wind Developers Group
GPS	-	Global Positioning System
GRP	-	Glass Reinforced Plastic
HAT	-	Highest Astronomical Tide
HF	-	High Frequency
HSE	-	Health and Safety Executive
HVAC	-	High Voltage Alternating Current
HVDC	-	High Voltage Direct Current
IALA	-	International Association of Marine Aids to Navigation and Lighthouses
ILB	-	Inshore Lifeboat
IMO	-	International Maritime Organisation
ITOPF	-	International Tanker Owners Pollution Federation Limited
kg		kilograms
kHz	-	Kilohertz
KIS-CA	-	Kingfisher Information Service – Cable Awareness
km	-	Kilometre
LAT	-	Lowest Astronomical Tide
LED	-	Light Emitting Diode
LORAN	-	Long Range Navigation
LPG	-	Liquefied Petroleum Gas
M	-	Metre
MAIB	-	Marine Accident Investigation Branch
MBS	-	Maritime Buoyage System
MCA	-	Maritime and Coastguard Agency
MEHRA	-	Marine Environmental High Risk Area
MGN	-	Marine Guidance Notice
MHWN	-	Mean High Water Neaps
MHWS	-	Mean High Water Springs

MLWN	-	Mean Low Water Neaps
MLWS	-	Mean Low Water Springs
MMO	-	Marine Management Organisation
MOC	-	Maritime Operations Centre
MRCC	-	Maritime Rescue Co-ordination Centre
MRSC	-	Maritime Rescue Sub-Centre
MSI	-	Maritime Safety Information
MW	-	Mega-Watt
NLB	-	Northern Lighthouse Board
nm	-	Nautical Miles
NOREL	-	Nautical and Offshore Renewables Energy Liaison Group
NRA	-	Navigational Risk Assessment
NVG	-	Night Vision Goggle
OREI	-	Offshore Renewable Energy Installations
OSP	-	Offshore Substation Platforms
PEXA	-	Practice and Exercise Area
PLA	-	Port of London Authority
PLL	-	Potential Loss of Life
PLN	-	Port Letter Number
RAF	-	Royal Air Force
REZ	-	Renewable Energy Zone
RNLI	-	Royal National Lifeboat Institution
Ro-Ro	-	Roll-on, Roll-off
RYA	-	Royal Yachting Association
SAR	-	Search and Rescue
SFF	-	Scottish Fishermen’s Federation
SFI	-	Sea Fisheries Inspectorate
SMS	-	Safety Management System
SPS	-	Significant Peripheral Structure
STW	-	Scottish Territorial Waters
TSS	-	Traffic Separation Scheme
UHF	-	Ultra High Frequency
UIC	-	Unique Identification Characters
UK	-	United Kingdom
UKCS	-	United Kingdom Continental Shelf
UKHO	-	United Kingdom Hydrographic Office
US	-	United States
VHF	-	Very High Frequency
VMS	-	Vessel Monitoring Service
VTS	-	Vessel Traffic Services
WTG	-	Wind WTG Generator

2. REGULATIONS AND GUIDANCE

2.1 *Introduction*

This section briefly summarises the key regulations and guidance relevant when considering the navigation safety issues associated with offshore wind farm developments and associated infrastructure in the UK.

2.2 *MCA Marine Guidance Notice 371*

This guidance notice (Ref. ii) highlights issues that need to be taken into consideration when assessing the impact on navigational safety from offshore renewable energy developments, proposed for UK internal waters, territorial sea or Renewable Energy Zones.

There are five annexes containing recommendations (1-4) and regulatory extract (5) as follows:

- Annex 1: Considerations on site position, structures and safety zones;
- Annex 2: Navigation, collision avoidance and communications;
- Annex 3: MCA shipping template, assessing wind farm boundary distances from shipping routes;
- Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning; and
- Annex 5: Standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around an OREI.

A checklist referencing the sections in this report which address MCA requirements is presented in Appendix B.

2.3 *MCA Wind Farm: 'Shipping Route' Template*

A trial performed by the MCA at the North Hoyle Offshore Wind Farm (Ref. v) indicated that WTGs provide erroneous returns to radar transceivers. Multiple side echoes may be generated that have the potential to mask real targets. This has been validated by more recent trials carried out by the industry on the Kentish Flats Wind Farm in the Thames estuary (Ref. vi). The onset range from the WTGs of these returns is about 1.5 nm, with a progressive deterioration in the radar picture as the WTGs are closed to about 500 metres (m). Adjustment of the radar controls can filter out some of these unwanted radar returns but comes at the cost of potentially losing small radar cross sectional targets such as buoys or small craft.

The MCA's Wind Farm Shipping Route Template (Annex 3 of Ref. ii), reproduced in Figure 2.1, indicates that WTGs within 0.5nm of a route will be Very High Risk. Close scrutiny and potentially mitigation will be needed between 0.5nm and 5nm to ensure risks are As Low as Reasonably Practicable (ALARP), particularly between 0.5nm and 2nm which is considered

Medium to High Risk. Beyond 2nm is Low Risk although an adjacent wind farm or Traffic Separation Scheme (TSS) introduces cumulative effects which have to be scrutinised.

The template is not a prescriptive tool but needs intelligent application to explore where the distance should be measured from, e.g., route centre, 90% traffic level, nearest ship, etc. The potential boundaries are illustrated in Figure 2.2.

Marine traffic survey information collected for the outer Firth of Forth area has been analysed in this study to inform such boundaries and investigate influencing factors such as route bias, vessel type, size, cargo, etc.

WIND FARM: "SHIPPING ROUTE" Template

Distance in miles (nm) of Turbine Boundary from Shipping Route	Factors	Risk	Tolerability
< 0.25nm (500m)	500m inter-turbine spacing = small craft only recommended	**VERY HIGH**	**INTOLERABLE**
0.25nm (500m)	X band radar interference	**VERY HIGH**	
0.45nm (800m)	Vessels may generate multiple echoes on shore based radars	**VERY HIGH**	
			TOLERABLE IF ALARP (As Low As Reasonably Practicable)* * Descriptions of ALARP can be found in a) Great Britain Health and Safety Executive (2001) Reducing risks protecting people b) IMO (2002) MSC Circ 1023 dated 5th April 2002 Formal Safety Assessment c) IMO (2007) MSC 83-21-INF2 Consolidated guidelines for Formal Safety Assessment
0.5nm (926m)	Mariners' high traffic density domain	**HIGH**	
0.8nm (1481m)	Mariners' ship domain	**HIGH**	
1 nm (1852m)	Minimum distance to parallel boundary of TSS	**MEDIUM**	
1.5nm (2778m)	S band radar interference ARPA affected	**MEDIUM**	
2 nm (3704m)	Compliance with COLREGS becomes less challenging	**MEDIUM**	
>2nm > (3704m)	But not near TSS	**LOW**	
3.5nm (6482m)	Minimum separation distance between turbines opposite sides of a route	**LOW**	
5nm (9260m)	Adjacent wind farm introduces cumulative effect Distance from TSS entry/exit	**VERY LOW**	**BROADLY ACCEPTABLE**
10nm (18520m)	No other wind farms	**VERY LOW**	

Figure 2.1 Wind Farm 'Shipping Route' Template (Ref. ii)

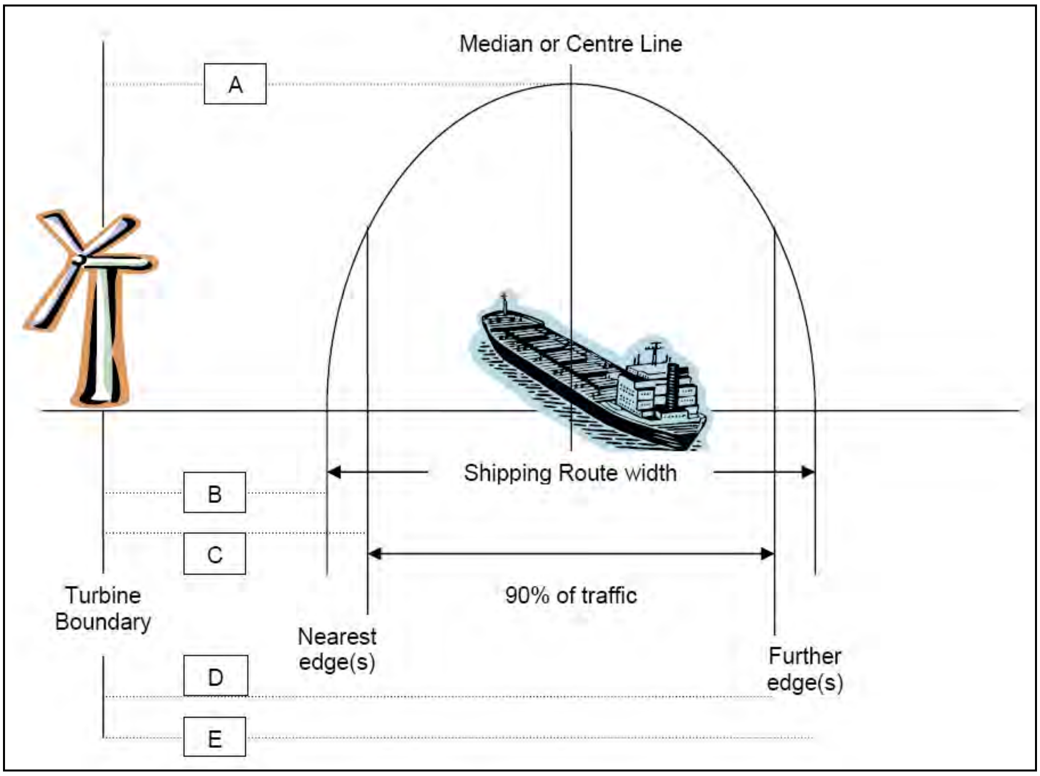

Figure 2.2 Interactive Boundaries require Interpretative Flexibility, where:

A = WTG boundary to the shipping route median or centre line
B = WTG boundary to nearest shipping route edge
C = WTG boundary to nearest shipping 90% traffic level*
D = WTG boundary to further shipping 90% traffic level*
E = WTG boundary to further shipping route edge
(* = or another % to be determined)

2.4 *DECC Methodology*

DECC produced a Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms in association with the MCA and the Department for Transport (DfT) (Ref. i).

Its purpose is to be used as a template by Developers in preparing their navigation risk assessments, and for Government Departments to help in the assessment of these.

The Methodology is centred around risk controls and the feedback from risk controls into risk assessment. It requires a submission that shows that sufficient risk controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with further controls or actions.

The key features of the Marine Safety Navigational Risk Assessment (NRA) Methodology are risk assessment (supported by appropriate techniques and tools), creating a hazard log, defining the risk controls (in a Risk Control Log) required to achieve a level of risk that is broadly acceptable (or tolerable with controls or actions), and preparing a submission that includes a Claim, based on a reasoned argument, for a positive consent decision.

Table 2.1 Key Features of the DECC Methodology (Ref. i)

1	Define a scope and depth of the submission proportionate to the scale of the development and the magnitude of the risk
2	Estimate the 'base case' level of risk
3	Estimate the 'future case' level of risk
4	Create a hazard log
5	Define risk control and create a risk control log
6	Predict 'base case with wind farm' level of risk
7	Predict 'future case with wind farm' level of risk
8	Submission

2.5 *Aids to Navigation*

The Phase 1 wind farms will be marked according to International Association of Marine Aids to Navigation and Lighthouses (IALA) guidelines (Ref. iii). The Northern Lighthouse Board (NLB) is the statutory body advising on the marking of Renewable Energy Installations in Scottish waters.

The Aids to Navigation (AtoN) required for the site during the different stages of construction, operation and decommissioning will be agreed with the NLB.

3. WIND FARM DEVELOPMENT DETAILS

3.1 *Introduction*

This section presents details of the proposed Phase 1 offshore wind farms (Project Alpha and Project Bravo) which are located off the east coast of Scotland.

3.2 *Phase 1 Wind Farms Overviews*

The proposed Project Alpha and Project Bravo sites are located in Phase 1 of the Firth of Forth Round 3 development Zone 2.

Phase 1 lies approximately 12nm[1] east of Red Head, just north of Arbroath on the Angus coast, and the boundary of Project Alpha is located approximately 18nm east of the Scottish coast.

Within the proposed wind farms, the water depth (lowest astronomical tide (LAT)) ranges from 38m to approximately 60m. Figure 3.1 presents a general overview of the Forth zone and the proposed wind farms within Phase 1.

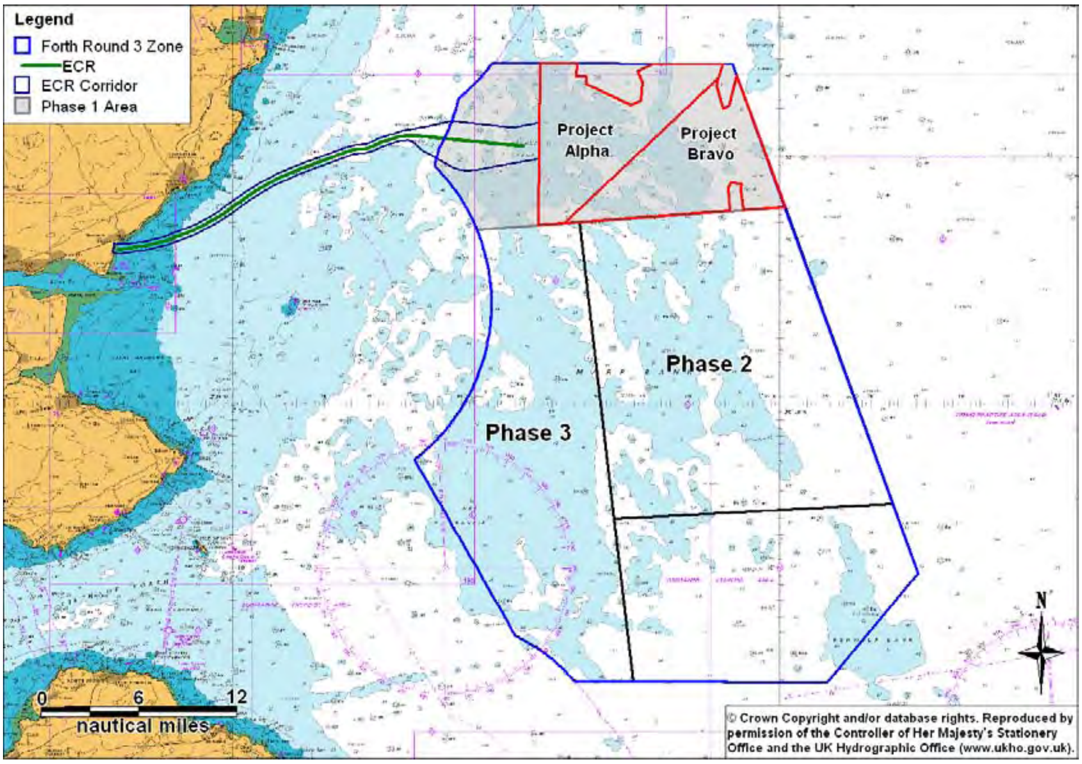

Figure 3.1 Overview Chart of Phase 1 Offshore Wind Farms (Project Alpha and Project Bravo)

[1] 1 nautical mile = 1.852 kilometres

3.3 *Project Boundaries and Coordinates*

Project Alpha is located in the central section of Phase 1 and covers an area of approximately 57 nautical miles squared (nm^2) (or 197 kilometres squared [km^2]). The project boundary is presented in Figure 3.2.

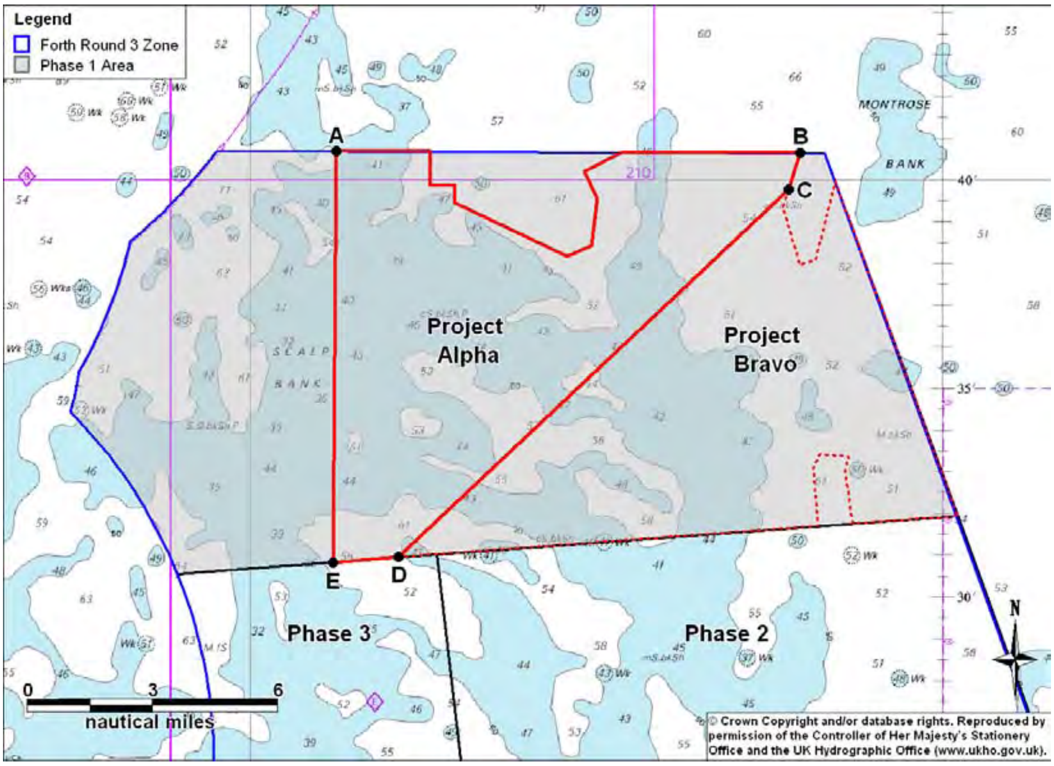

Figure 3.2 Detailed Chart Overview of Project Alpha

The corner coordinates of the Project Alpha site are presented in Table 3.1.

Table 3.1 Project Alpha Corner Coordinates (WGS 84)

Corner	Latitude	Longitude
A	56° 40' 39.1910" N	001° 56' 13.5644" W
B	56° 40' 36.3706" N	001° 36' 09.0449" W
C	56° 39' 43.7119" N	001° 36' 38.9793" W
D	56° 30' 55.3865" N	001° 53' 32.4831" W
E	56° 30' 48.1896" N	001° 56' 22.6759" W

Project Bravo is located in the eastern part of Phase 1 and covers an area of approximately 56nm^2 (194km^2). The project boundary is presented in Figure 3.3.

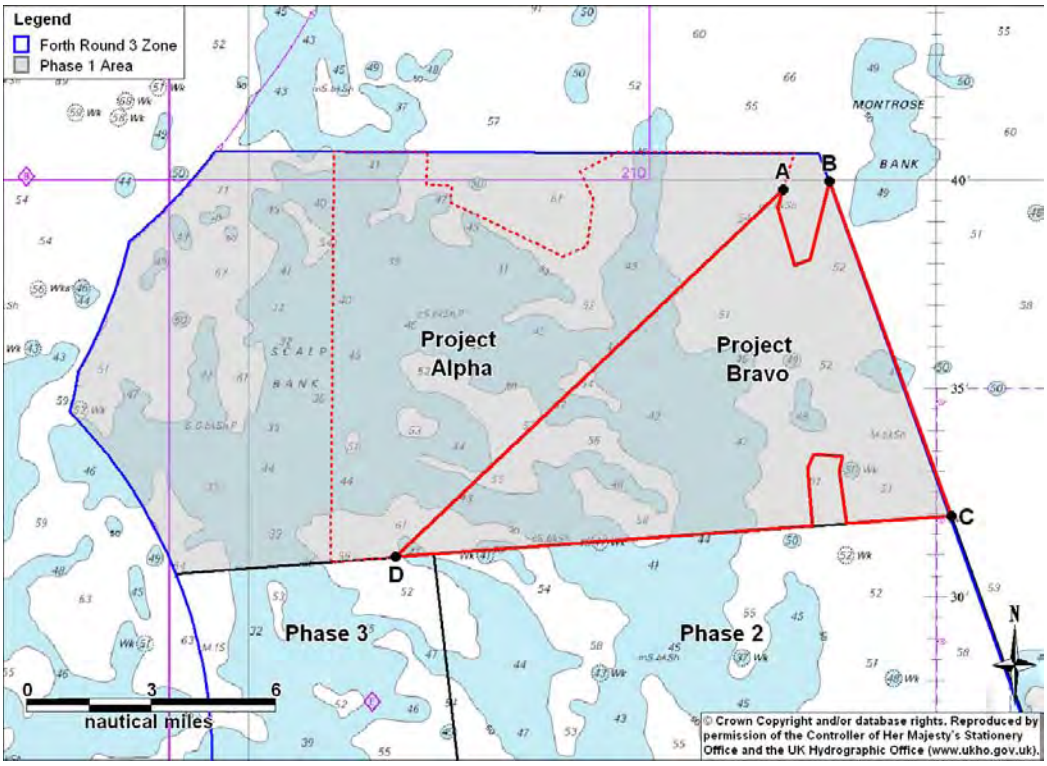

Figure 3.3 Detailed Chart Overview of Project Bravo

The corner coordinates of the Project Bravo site are presented in Table 3.2.

Table 3.2 Project Bravo Corner Coordinates (WGS 84)

Point	Latitude	Longitude
A	56° 39' 43.7119" N	001° 36' 38.9793" W
B	56° 39' 55.3965" N	001° 34' 37.6193" W
C	56° 31' 54.1929" N	001° 29' 18.6751" W
D	56° 30' 55.3865" N	001° 53' 32.4831" W

3.4 *Structure Details*

The strategy adopted by Seagreen to retain design flexibility is to adopt a 'Rochdale Envelope' approach. Further details on the Rochdale Envelope approach can be found in the Seagreen Project Phase 1 Environmental Statement (Ref. vii). For a number of the project components for both Project Alpha and Project Bravo, engineering decisions regarding preferred options and final design details have not yet been made. This includes decisions on the WTG array layouts, the WTG specification and supplier, foundation type and installation methodology, and the electrical design. Retaining flexibility in the selection of preferred design options is a vital mitigation in the management of project risks and enables significant procurement commitments to be made at a more appropriate time later in the process.

The risk modelling for the NRA has been carried out separately for Project Alpha and Project Bravo.

For both projects, models have been run assuming 75 WTGs per site with a minimum separation distance of five rotor diameters (no less than 610m based on a rotor diameter of 122m). Table 3.3 summarises the minimum and maximum WTG dimensions for WTGs proposed within Project Alpha and Project Bravo.

Table 3.3 Minimum and Maximum WTG Dimensions

	Minimum	Maximum
WTG Diameter at Sea Level (m)	30	30
Rotor Diameter (m)	122	167
Blade Clearance above LAT (m)	26.1	42.7
Hub Height above LAT (m)	87.1	126.2
Tip Height above LAT (m)	148.1	209.7

There will also be a maximum of three meteorological masts (met masts) per project, with a diameter at sea level of no more than 30m, which have been included in the collision risk modelling. The meteorological mast height will be between 87.1m and 209.7m above LAT. Transmission asset infrastructure found within the wind farms will include Offshore Substation Platforms (OSPs) and high voltage export cables. Retaining the flexibility to select connection design is essential. High Voltage Direct Current (HVDC) is a new technology for offshore wind that may provide improved connection efficiency. High Voltage Alternate Current (HVAC) is the established technology and has been used on previous offshore wind installations in the UK. Project Alpha and Project Bravo are close to the limit for technical feasibility due to capacity and transmission distances. It is not possible to commit at this stage to either technology as it is not yet certain which will provide the optimum or most cost effective solution. For this reason both HVDC and HVAC technologies have been included in the NRA.

There are currently four scenarios for connection design configurations. For the worst case collision risk modelling, it has been assumed that there will be up to five OSPs which includes four HVAC Collector Stations and one HVDC Converter Station within the Phase 1 wind farms. The maximum dimensions of the HVAC collector stations are 40m x 40m. The maximum dimension of the HVDC converter station is 100m x 75m. These stations have been positioned on the periphery of the wind farm boundaries for the worst case collision risk modelling as this is where they are the most exposed.

The layout of the above wind farm and transmission asset structures within Project Alpha and Project Bravo are presented in Figure 3.4 and Figure 3.5 respectively. For the purposes of this

NRA, it has been assumed that Project Alpha and Project Bravo will be filled to full site capacity (i.e. creating the maximum footprint within the sites).

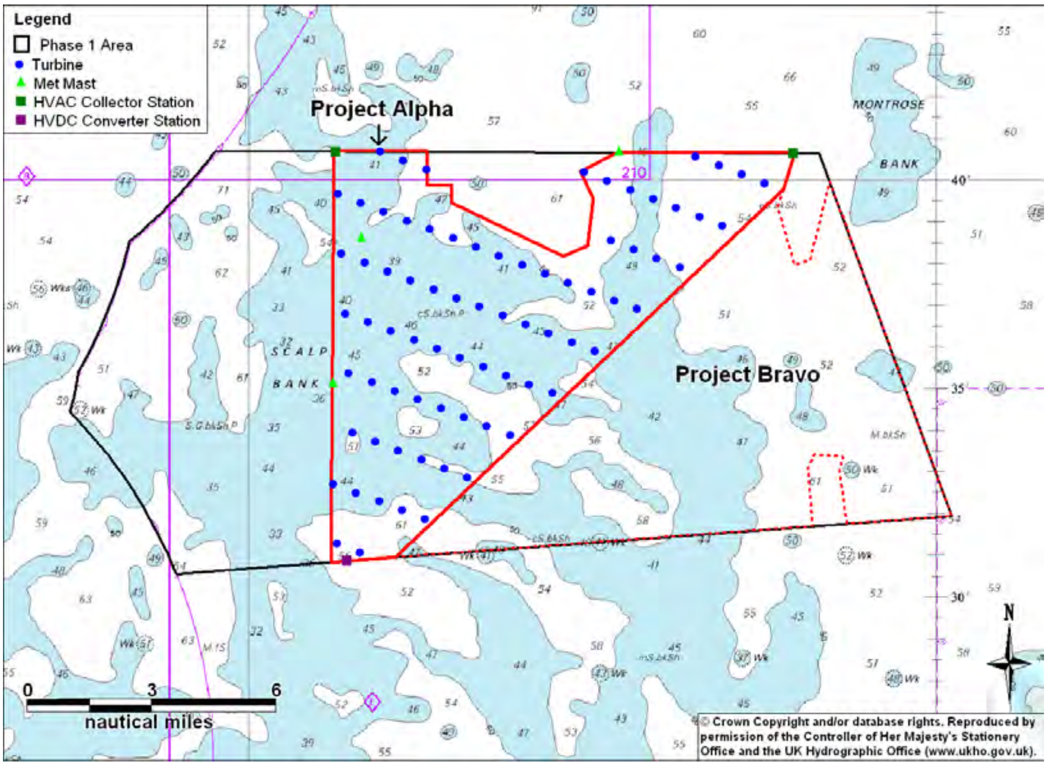

Figure 3.4 Indicative Structure Layout in Project Alpha

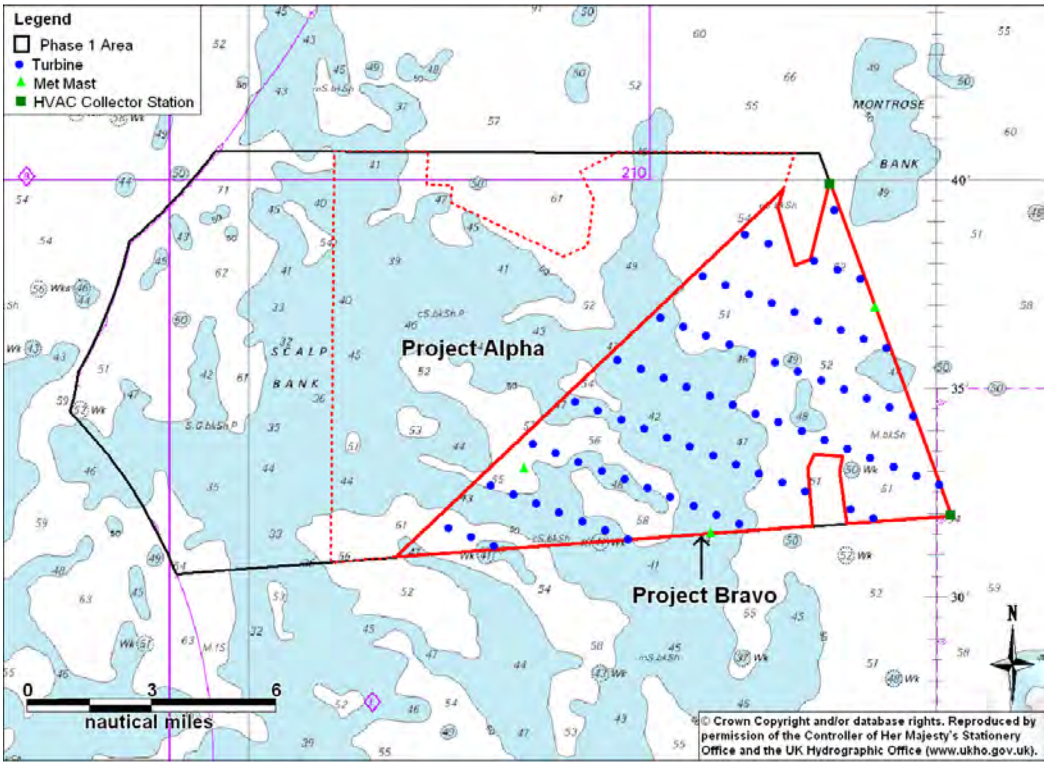

Figure 3.5 Indicative Structure Layout in Project Bravo

It has been acknowledged that, for the assessment of cumulative effects, both sites filled to their maximum capacity should be considered together. This layout is presented in Figure 3.6.

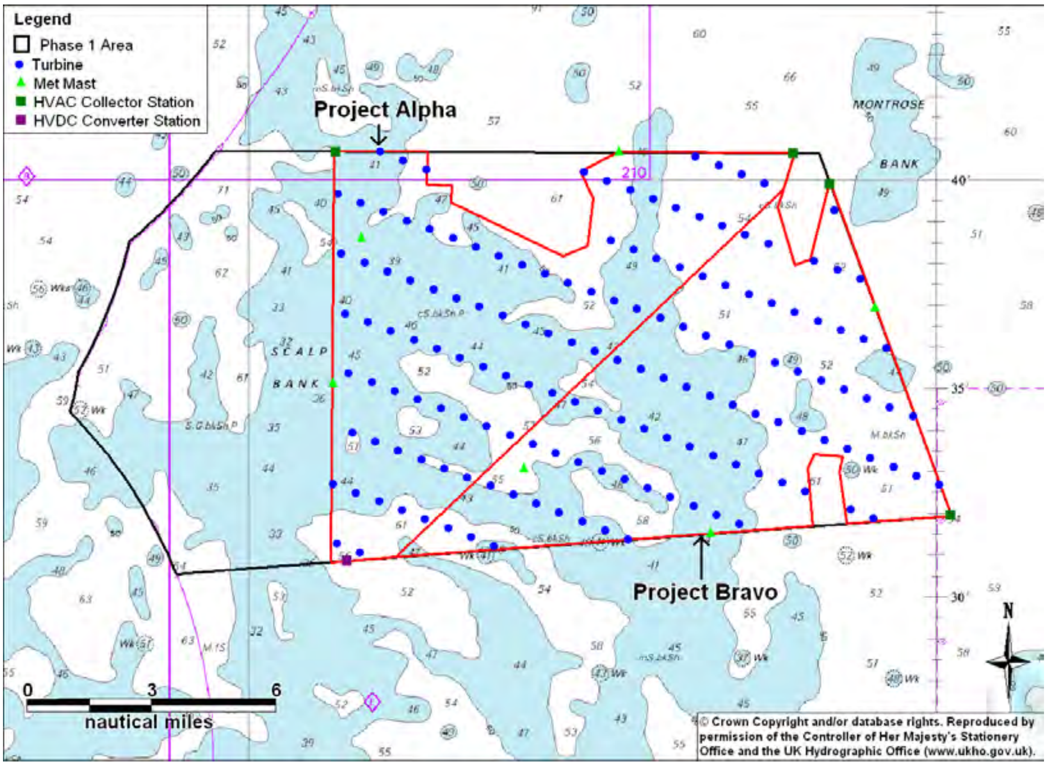

Figure 3.6 Indicative Layout for Cumulative Analysis

A variation of this layout which does not contain any wind farm structures along the boundary between Project Alpha and Project Bravo is presented in Figure 3.7. This gap is approximately 1.5nm wide and may be used by vessels navigating in the area, therefore creating an addition hazard due to vessels transiting in a narrow gap in close proximity to wind farm structures where there may be crossing traffic. It also creates an issue with vessels emerging from the gap into traffic adjacent to the wind farm. Cumulative effects will be discussed in detail in Section 18.

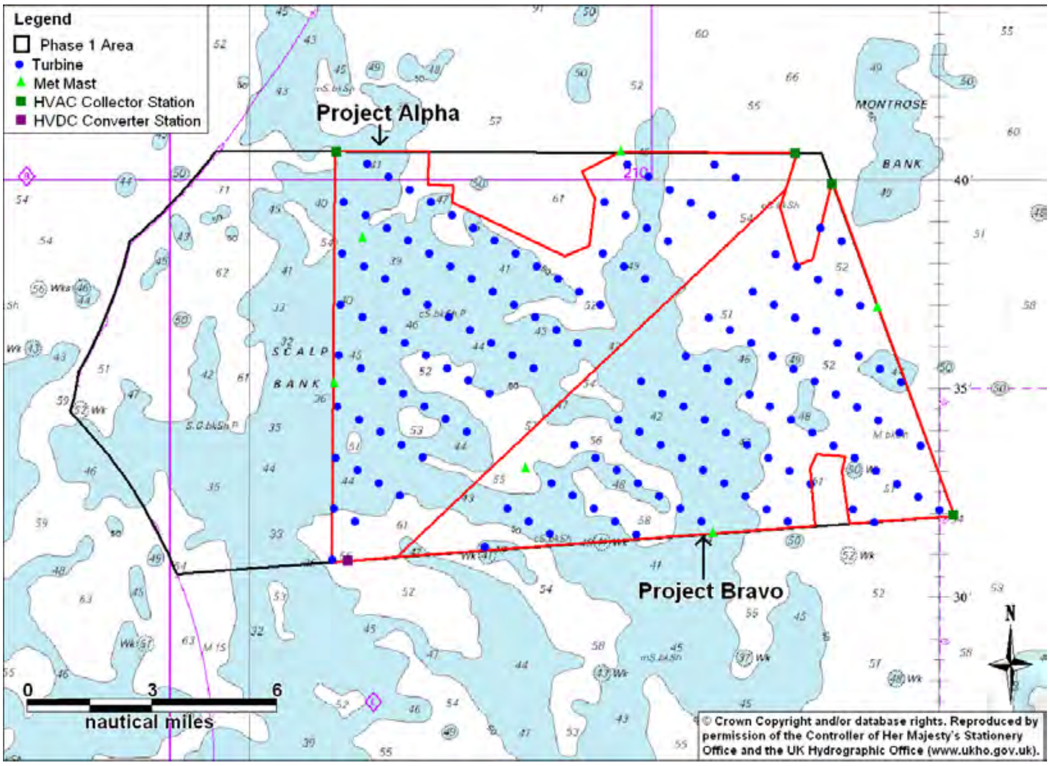

Figure 3.7 Variation on Indicative Layout for Cumulative Analysis

3.5 *Wave Buoys*

"In addition to the structures described above and presented in the indicative layouts, there will also be six wave buoys deployed around the offshore wind farms (three in Project Alpha and three in Project Bravo). The wave buoys are approximately 1m in diameter and will be moored to the seabed in close proximity to the boundary of the wind farm.

The purpose of these wave buoys is to measure wave characteristics to feed into the development of a forecast model for the region. The buoys will be protected by guard buoys which will be deployed with their associated mooring and are intended to increase the visibility and awareness of the location of each of the buoys. Each wave buoy will be fitted with light-emitting diode (LED) flashlight, colour yellow (visibility of approximately 5nm) which will operational during the hours of darkness, a triangle outer mounting to deflect ship strikes and an additional radar reflector fitted to enhance radar visibility. A 350m clearance around each of the wave buoys will be requested. The buoys are intended to be deployed for a period of three years and will be serviced on a six monthly basis.

Due to the position and size of these structures it was not felt that detailed modelling was required and they were therefore not included in the collision risk modelling for Project Alpha or Project Bravo."

3.6 *Array Cables*

The total length of array cables for Project Alpha will be between 335m and 355m with the majority of cables (at least 299.5m) being trenched and rock or mattress protection being used where this is not possible. The same details apply for array cables for Project Bravo.

3.7 *Export Cable Route*

An overview of the Export Cable Route (ECR) making land fall south of Carnoustie is presented in Figure 3.8.

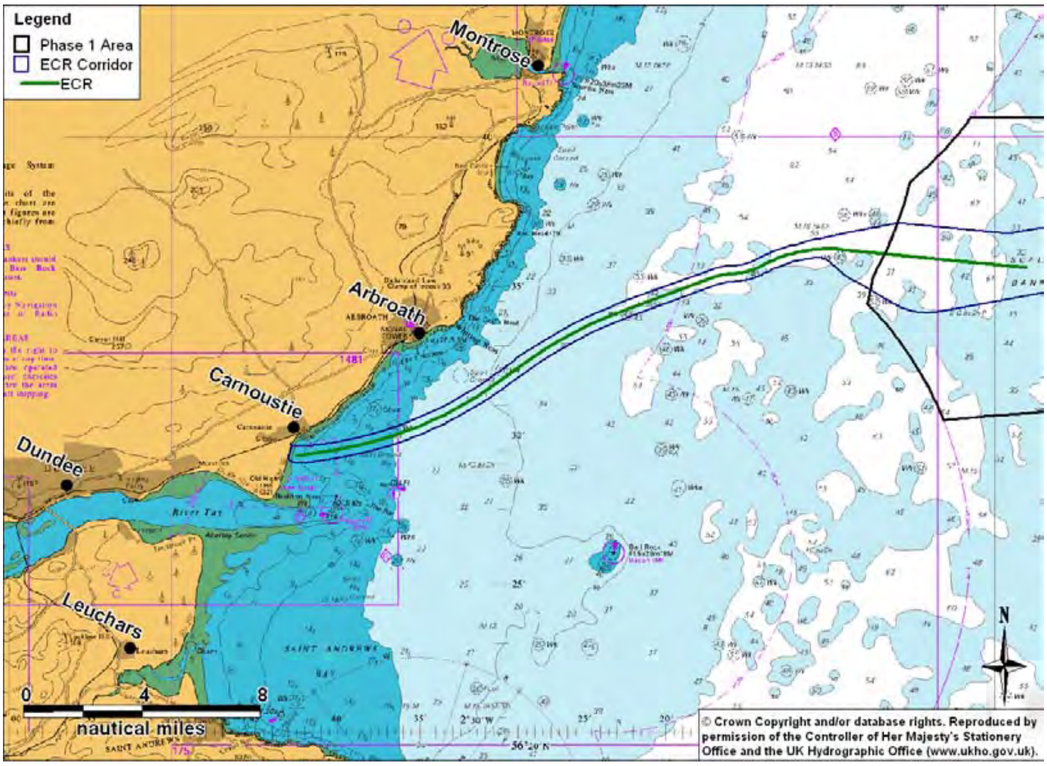

Figure 3.8 Chart of ECR Corridor

The ECR corridor runs from the western boundary of Project Alpha to the landfall site approximately 0.75nm south of Carnoustie. The majority of the proposed ECR corridor is 0.5nm in width. Adjacent to the western boundary of the Zone, however, it widens to approximately 2.9nm to allow flexibility for the cable routing to the OSP locations within the Project Alpha site, once that is determined.

The Rochdale Envelope for the project states that the high voltage export cables will be primarily trenched/buried but could be protected with other means, such as rock protection or mattresses, along some of the route where necessary. Where cables are trenched, the burial depth will be between 0.5m and 3m, with the estimated width of the trench being 3m.

There will be up to three single core cables in separate, parallel trenches within the ECR corridor; this gives a maximum of six trenches in total. Fibre optic control cables will also be laid in two of the trenches.

4. MARINE NAVIGATIONAL MARKINGS

4.1 *Introduction*

Throughout the project, marine navigational markings will be provided in accordance with the NLB requirements, which will comply with IALA Recommendation O-139, 'Marking of Offshore Wind Farms' (Ref. iii), and the additional requirements of MCA MGN 371 (Ref. ii). It is also noted that there is a requirement to mark selected structures with lights for aviation as per Civil Aviation Authority (CAA) requirements.

NLB have advised that final marking and lighting recommendations will be made in a formal response through Section 36 of the Scottish Executive (2002). Electricity Act 1989 (Requirement of Consent for Offshore Generating Stations) (Scotland) Order 2002. Scottish Statutory Instruments 2002 No. 407 Electricity. and through the Marine Licence under the Marine and Coastal Access Act 2009 to be considered in conjunction with the Section 36 consent applications. All navigational marking and lighting of the wind farm sites or its associated marine infrastructure will require the Statutory Sanction of the NLB prior to deployment.

4.2 *Construction/Decommissioning*

During the construction/decommissioning of an offshore wind farm, working areas will be established and marked in accordance with the IALA Maritime Buoyage System (MBS). In addition to this, where advised by NLB, additional temporary marking will be applied.

Notices to Mariners, Radio Navigational Warnings-NAVTEX and/or broadcast warnings as well as Notices to Airmen will be promulgated in advance of and during construction/decommissioning of any individual structure/farm.

4.3 *Marking of Individual Structures*

The tower of every wind generator will be painted yellow all round from the level of HAT to 15m or the height of the AtoN if fitted, whichever is greater.

As per the MCA requirements, each of the structures will be marked with clearly visible Unique Identification Characters (UIC) at a location that is easily and readily serviceable. The UIC will each be illuminated by a low-intensity light, so that the sign is visible from a vessel thus enabling the structure to be detected at a suitable distance to avoid a collision with it. This will be such that under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer (with naked eye), stationed 3m above sea levels, and at a distance of at least 150m from the WTG. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation marks.

4.4 *Proposed Markings*

The markings for the projects will be agreed in consultation with NLB once the final WTG layout has been selected. Based on IALA guidelines it is likely that the lighting of each wind farm and the overall Phase 1 wind farms will be:

- All corner towers will be marked as Significant Peripheral Structures (SPSs) and where necessary, depending on spacing, intermediate towers on each of the north, west, east and south facing boundaries will be marked as Intermediate Structures;

- In all the layouts, towers designated as SPS are to exhibit Flashing Yellow 5 second (Fl Y 5s) lights of 5nm nominal range and omnidirectional fog signals with a character of 1 blast of 2 seconds duration every 30 seconds and an IALA usual range of 2nm. Towers designated as Intermediate Structures are to exhibit Fl Y 2.5s lights of 2nm nominal range;

- All the lights are to be visible to shipping through 360 degrees and if more than 1 lantern is required on a tower to meet the all-round visibility requirement, then all the lanterns on that tower should be synchronised;

- All the lights are to be exhibited at the same height at least 6m above HAT and below the arc of the WTG blades;

- All the lights are to be exhibited at least at night and when the visibility is reduced to 2nm or less. Fog signals are to be sounded at least when the visibility is 2nm or less;

- All the structures in the boundary of the WTG towers are to be coloured yellow from at least HAT to the height of the lights (the equivalent height on the unlighted structures); and

- Any lighting required for aeronautical purposes is to be shielded / arranged such that it is not visible to shipping. If this cannot be achieved, then the requirement will be considered as having been met if the aviation light is reduced to 10% of its peak intensity when the visibility is more than 5km.

4.5 *Superintendence and Management*

Seagreen will ensure that they have a reliable maintenance and casualty response regime in place such that the required availability targets are met.

5. CONSULTATION

5.1 *Introduction*

Consultation on navigational issues has been carried out with stakeholders during the development of the projects. This section summarises the key consultation meetings and responses received following the submission of the EIA Scoping Report (Ref. viii) which was reviewed to highlight the key issues relating to the proposed wind farm developments.

It is noted that, as part of the FTOWDG, regional consultation was carried out by means of stakeholder meetings and remote consultation with regular vessel operators.

Consultations carried out during this process were on the basis of the entire Phase 1 area being developed as, at the time, the perimeter of Project Alpha and Project Bravo had not been defined.

5.2 *Scoping Responses*

A summary of the main stakeholder scoping responses are presented within the following subsections.

5.2.1 Fife Council Development Services

The impact on the Port of Rosyth should be assessed in terms of possible future development of European shipping routes.

5.2.2 Forth Estuary Forum

The Forth Estuary Forums stated that they would like to see high quality, temporally sensitive navigational data to be collected, rather than an average over several years of existing data.

5.2.3 Forth Ports

Forth Ports noted that they will be interested in obtaining the results of the navigation study and are more than willing to assist studies. Forth Ports are fully supportive of the wind farm development and are available to contribute to the planning and construction process both from a navigation point of view and the utilisation of port facilities.

5.2.4 Marine Scotland

The NRA should be carried out according to MGN 371.

5.2.5 MCA

The NRA should be submitted in accordance with MGN 371 (and 372) and the DfT/MCA Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms. Particular attention should be paid to cabling routes and burial depth and, subject to the traffic volumes, an anchor penetration study may be necessary.

The NRA will cover issues for both commercial and recreational craft, based on the following:

- Collision risk;
- Navigational safety;
- Risk management and emergency response;
- Marking and lighting of site and information to mariners;
- Effect on small craft navigational and communication equipment;
- Weather and risk to recreational craft which lose power and are drifting in adverse conditions;
- Evaluation of likely squeeze of small craft into routes of larger commercial vessels; and
- Visual intrusion and noise.

Radar effects of offshore wind farms on ship's radars are an important issue and subject to further discussion within the radar sub group of Nautical Offshore Renewable Energy Liaison (NOREL). The radar effects will need to be assessed on a site specific basis.

5.2.6 Northern Lighthouse Board

As part of the formal application, the NLB would require that a full NRA is undertaken. NLB assumes that any formal recommendations for lighting and marking will be given through the Coast Protection Act 1949 – Section 34 process.

The Statutory Sanction of the Commissioners of Northern Lighthouses must be sought to deploy, exhibit and subsequently remove any proposed navigational lighting or buoy stations required within any conditions of the consent to establish the offshore wind farms or for any preparatory work.

NLB also noted that it is important to understand the departure and arrival ports of transiting vessels as any deviation around this development (or accumulation of developments) may have an impact on both shipping and port operations.

5.2.7 Royal National Lifeboat Institute

Royal National Lifeboat Institute (RNLI) stated that the whole site area lies within the RNLI's coverage (100nm from the UK coast). The RNLI also raised concern over increased potential for casualties due to the impacts on the major shipping routes and more particularly on those areas visited by the commercial fishing industry.

5.2.8 Royal Yacht Association

The Royal Yacht Association (RYA) would expect that recreational boating should be considered under Shipping and Navigation (including the NRA) as well as in Tourism and Recreation.

5.3 *Hazard Review Workshop*

A hazard review workshop was held in Dunfermline on the 18 January 2012. The purpose of the workshop was to identify and review the potential navigational hazards associated with the proposed Phase 1 offshore wind farm developments and the ECR corridor with input from local navigational stakeholders.

Note that project boundaries and layouts had not been finalised at the time of the hazard workshop so it was assumed that wind farm structures could be located anywhere within Phase 1.

The following stakeholders attended the hazard workshop:

- NLB;
- MCA;
- Marine Scotland;
- Kingdom Seafood/FMA Ltd;
- Anglo-Scottish Fisherman's Federation;
- Scottish Fisherman's Federation (SFF);
- Forth Ports Ltd; and
- RYA Scotland.

Additional details on the workshop are provided in Section 13. A full methodology and results are provided in Appendix C and a comprehensive log of the minutes recorded are presented in Appendix D.

5.4 *Forth and Tay Offshore Wind Developers Group Consultation*

Consultation on navigational issues was carried out during the FTOWDG regional work to gather input from the marine community (Ref. iv). It was carried out using three different methods as follows:

1. Meetings

Meetings were held with and presentations made to the following:

- The Chamber of Shipping (CoS);
- Forth Ports Ltd;
- NLB;
- DfT; and
- MCA.

2. Remote Consultation

Regular vessels using the region were identified and provided with an information pack detailing the proposals. The pack requested feedback on the proposals and also invited further consultation should the stakeholder consider this necessary.

3. Other Presentations

A dedicated presentation was also given to:

- RYA

Summary details of the main feedback relevant to the Phase 1 offshore wind farms are provided in the following sub-sections.

5.4.1 The Chamber of Shipping

A meeting was held at the CoS offices in London on 11 January 2011. The objective of the meeting was for FTOWDG to present an overview of the regional shipping and navigation study approach, to seek a preliminary response from CoS on the study methodology and proposed strategy to communicate the findings to key shipping and navigation stakeholders. A summary of the main points is provided below:

- CoS stated that FTOWDG need to consider ship-to-ship transfers (which were proposed near the entry of the Firth of Forth in 2008). These ships have deeper draughts (up to 23m) and need to be considered in the assessment[1].

- CoS also commented on a number of the shipping routes identified to pass through the region. Their main comments on the relevant routes was as follows:

  - Shipping passing through the Forth Zone north/south from Aberdeen to north east England – current alternative route scenario (vessels will pass east of all of the developments) is worthy of consideration, however it limits ships to 'non-sheltered waters', providing them with no inshore route for over 30 miles

[1] It is noted that at the time of writing in June 2011, regulations were to be implemented by the UK Government which would ban ship-to-ship transfers in open water apart from off the Suffolk coast. Therefore rules would prevent oil transfers occurring outside port/harbour authority limits, (i.e. in the outer Firth of Forth off Bass Rock and Isle of May).

(assuming the entire Forth Zone is developed). Dialogue with vessel operators and seasonal Automatic Identification System (AIS) data could provide some information about current navigation strategies in extreme weather circumstances.
    - Shipping passing through Inch Cape and the Forth Zone from Montrose to Holland – there are merging traffic issues (tankers and cargo affected). In the alternative route scenario presented (vessels will pass west of developments/inshore) which increases the density of shipping along an existing shipping route east and west of Bell Rock. Safety concerns raised by the CoS. Should also consider alternative route between Inch Cape and Neart na Gaoithe.

- In general discussion the CoS stated that even one vessel per day on any given route could be strategically important and must therefore be given due consideration in the regional shipping and navigation study.

- The CoS supports the concept of shipping lanes through offshore wind farm sites. Future designated shipping lanes within the UK will provide clarity for prospective offshore wind farm developers[1].

5.4.2 Forth Ports

A meeting was held with the Forth Ports in January 2011. The objective of the meeting was for FTOWDG to consult with the main ports in the area which are operated by Forth Ports PLC. A summary of this meeting is provided below.

<u>Vessel Activity in the Region:</u>

- Forth ports have 20-22 movements a day (in 24hour period). They stated that this is not that busy in terms of the number of movements, but is significant in terms of tonnage;

- Oil and gas accounts for 80%-90% of Forth Ports business and around 60 cruise liners visit in the summer;

- Regarding coastal tankers routeing to/from Grangemouth, BP lost the contract in 2011, hence the *Border* vessels now mainly work out of Immingham, and these vessels now pass further east of the coast when supplying fuel to ports around Scotland;

- It was noted that no ship-to-ship transfers take place in the Forth area as government regulations only permit ship-to-ship transfers inside their port limits. In addition, it

[1] (It was noted by FTOWDG developers that no plans for designated shipping lanes are proposed for the outer Firth of Forth and Tay region.)

was stated that anchorages are generally further inshore as depicted on admiralty charts;

- No major tidal variation. The vessels will sit at anchor as opposed to slowing down in the North Sea; and

- It was thought that it is probably personal preference as to why vessels go East/West of Bell Rock. It could be that smaller vessels go closer to the coast for shelter.

Issues Discussed:

- General concerns were expressed regarding smaller vessels being pushed further offshore and the impact on them being further east and hence out in heavier weather; and

- Forth Ports felt the impact could be reduced by having a route through the middle between Neart na Gaoithe and Inch Cape for the deviated route from both Forth and Dundee.

Future Developments:

- Future developments in the Forth include the potential for three to four biomass plants, which if constructed could bring in an increased number of large bulk carriers.

5.4.3 Maritime and Coastguard Agency and Department for Transport

A meeting was held with the MCA and the DfT in January 2011. The objective of the meeting was for FTOWDG to consult and discuss the collaborative works and outline each of the projects and the subsequent development programmes. A summary of this meeting is provided below.

Background and Data Collection:

- MCA discussed the datasets used in the analysis and asked that AIS, Vessel Monitoring Service (VMS), Catch Data and radar data are included in the final regional assessment. It was noted that the current data set was only for 28 days AIS and the intention is to expand the study covering the longer term data collection across the region[1]; and

- It was highlighted that the AIS data tracks showed poor coverage in the south of the Firth of Forth Round 3 Zone 2 and it was informed that the data used was from last year's collection (2010). In response to this it was noted the recording station in the south of the region had since been re-located to provide greater coverage in this area.

[1] (AIS shipping data provided in the report covers the combined survey period from August 2009 to July 2011);

General Points:

- Overall the MCA were supportive of the approach taken in the regional assessment, however they are of the opinion that the majority of stakeholders are likely to be uncomfortable with many of the route change proposals, especially those around Bell Rock. Without stakeholder support, the MCA would be unable to support the route changes;

- MCA requested further analysis to understand the percentage of traffic in the area that comprises regular running vessels as this would help to identify the appropriate stakeholders to meet/consult;

- It was emphasized that the assessment must consider what hazards are created by the suggested route changes and that reference to potential impacts of WTGs on radar and how this is impacted on the route changes;

- The MCA suggested that when looking at all the routes in and around Bell Rock, an assessment needs to be made on the increase in shipping densities and encounters; and

- DfT asked that offshore accommodation, maintenance, Search and Rescue (SAR) were considered by the developers later in the individual projects.

5.4.4 Marine Stakeholder Consultation

Shipping operators were identified and contacted for feedback on the potential impact of the proposals on the navigation from regional development of the area. A summary of the main feedback received relevant to the Phase 1 developments is presented below.

Solstad (offshore vessels):

- The regional developments will not affect their operations. In general, port callings are to Aberdeen or Peterhead. If vessels pass through the region following construction of wind farms, Solstad indicated that they would not have any problems navigating through the wind farms.

Transmarine Management ApS (tankers bound for Dundee):

- Initial findings are that when Transmarine Management ApS ships are bound to Dundee (in-ward) the developments are not a problem, but when leaving Dundee for direction Skaw (Skagen), Denmark they will require re-routeing.

SAGA Cruises (cruise vessels)

- In general the proposals do not pose a safety risk to SAGA Cruise vessels.

Fred Olsen Cruises (cruise vessels):

- Fred Olsen Cruises transit the area, especially during the summer months, however they have no concerns regarding the impact on operations.

James Fisher Everard (coastal tankers bound for Forth, Tay and Northern Ports):

- No comments were supplied during the regional work.

Armac Marine Management Ltd (cargo vessels bound for Montrose):

- Some routes will be affected but provided that the constructions are adequately marked and correctly charted, Armac Marine Management Ltd does not have any concerns regarding safe navigation, (the opinion of several Masters in the company).

6. EXISTING ENVIRONMENT

The Firth of Forth comprises of the land locked estuary stretching from around the Isle of May to Alloa. The outer Firth also encompasses a number of coastal harbours and two important water ways, the Firth of Tay and the Firth of Forth. This section presents the following baseline information relating to navigation in the outer Firth of Forth:

- Ports and Harbours
- Navigational Aids
- Sailing Directions
- Wrecks
- Oil & Gas Infrastructure
- Other Navigational Features i.e. military exercise areas, disposal sites etc
- Marine Environmental High Risk Areas (MEHRAs)
- Metocean data

6.1 *Ports and Harbours*

A chart overview of the region relative to the main ports and harbours is presented in Figure 6.1.

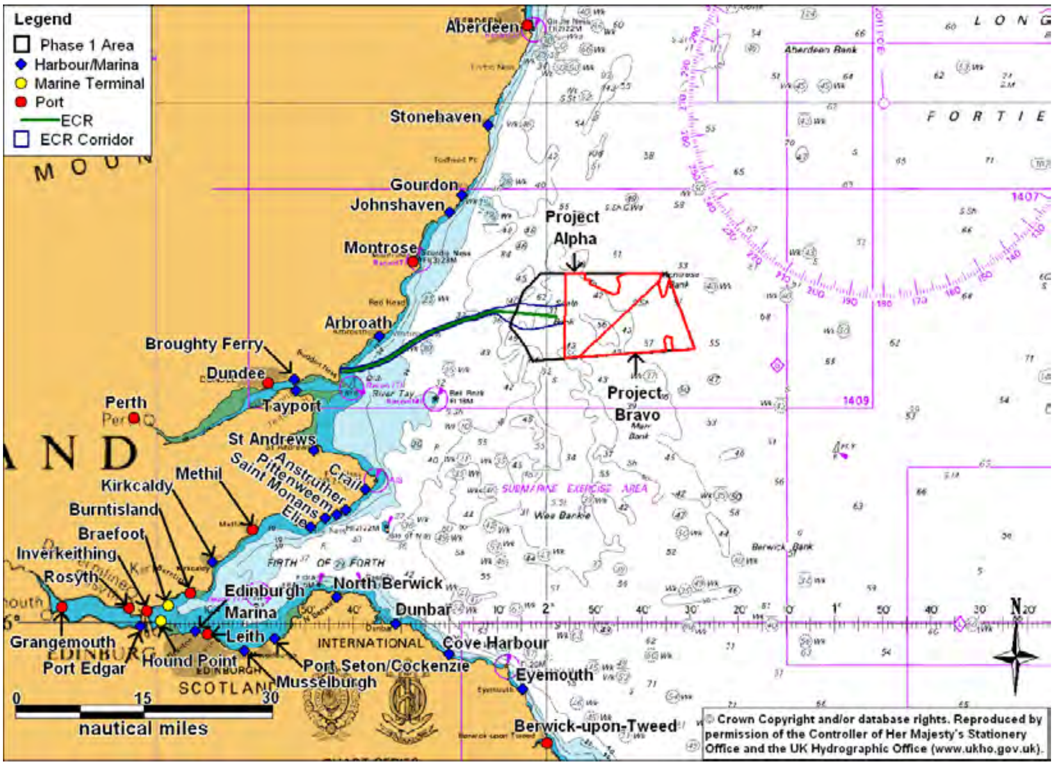

Figure 6.1 Overview of Ports and Harbours in the Area

A number of harbour facilities and ports are located within the Firths of Forth and Tay, with smaller harbours (mainly fishing and recreational) located along the Angus, Fife and East Lothian coastlines.

A summary of the facilities at the main ports, harbours and marinas is provided in the following sub-sections.

6.1.1 Maximum Limiting Conditions

The port of Grangemouth, operated by Forth Ports Ltd., can handle the largest vessels in the area, with draughts up to 11.7m. The port of Leith is also able to accommodate vessels up to 210m and draught 9.1m, (however larger vessels can be berthed dependant on tidal conditions).

It is noted that larger vessels also enter the Firth of Forth bound for the Hound Point and Braefoot Oil and Gas terminals. The Hound Point Oil Terminal can accommodate tankers of draught 21.64m (springs) and 20.71m (neaps) tides.

6.1.2 Forth & Tay Navigation Service/Pilotage

Forth and Tay Navigation Service is manned 24 hours a day (all year) by personnel who are supported by Vessel Traffic Services (VTS Operators. The service they provide includes radar surveillance of the Forth Estuary from the Eastern Port Limit (Tantallon Castle on the south shore to Fife Ness on the north shore) and of the Tay Estuary from the Abertay Outer Buoy to a position just west of the Tay Rail Bridge.

The Forth and Tay Navigation Service duties also include enforcement of the Forth Byelaws and general directions for Navigation and the Byelaws for the Port of Dundee. This ensures safety and efficient passage of all shipping passing through the Forth Ports and Harbour limits. Forth Ports has five radars covering the Forth Estuary; at Gullane, Leith, Burntisland, Port Edgar and Grangemouth and one radar at Buddon Ness on the Tay.

Forth Ports Ltd. exercises compulsory pilotage for passenger-carrying vessels and for other vessels in Forth Deep Water Channel and its immediate vicinity and in the firth/river as a whole (west of 3°, 15.4 minutes W). Pilotage is also compulsory for vessels over 8,000 Dead Weight Tonnage (DWT) bound for Leith and vessels using the Eastern Channel lying within Grangemouth Docks. However vessels bound for a closed dock, lock or other closed limits, are generally excluded from compulsory pilotage.

Pilotage is compulsory in the Dundee Pilotage District, which extends to the port limits south by south west of the Fairway Light-buoy. In terms of pilotage in the inner Firth of Tay, this is not compulsory however masters are strongly advised to make use of the services of a local pilot which will be arranged by the Perth Harbour Master.

6.1.3 North East Ports/Harbours

Aberdeen port is the main marine support centre for the North Sea oil and gas industry. In addition to the oil and gas support services there are regular shipping services to Orkney, Shetland and Scandinavia via roll on/roll off (Ro-Ro) services for passengers and cargo.

Aberdeen also has a large modern fish market and although there are no commercial fisheries within the area of jurisdiction of Aberdeen Harbour or proximity, deep-sea fishing vessels and a number of locally registered potters land their catches at the Aberdeen fish market located at Palmerston Quay. The maximum size of a vessel accommodated is 160m, beam 23m and draught of 9.1m.

Stonehaven is formerly a fishing port, now mainly used by recreational craft and a small number of inshore fishing boats. The maximum size of a vessel accommodated is 34m and draught of 3m.

Gourdon is a fishing station 1 mile south by south west of Inverbervie. There is an outer harbour and a breakwater, which is used by recreational vessels. The main harbour is used by fishing vessels.

Johnshaven has a harbour which dries and consists of two basins separated by a jetty. The harbour provides shelter for fishing boats in all weathers.

Montrose is formally a small commercial and fishing port but has seen an increase in its commercial activity over recent years, mainly as a result of the offshore industries. Vessels up to 165m in length and 7m in draught can be accommodated.

Arbroath is mainly a fishing port used by medium and small fishing vessels. It also has a small marina for sailing vessels.

6.1.4 Tay Ports

Broughty Ferry harbours is a lifeboat station, with one All-weather Life Boat (ALB) and one Inshore Life Boat (ILB).

Tayport Harbour has a small tidal harbour and marina which dries on low tide.

Dundee is the main port handling general cargo and imports of crude oil. The repair and servicing of offshore gas and oil installations is also undertaken at Dundee. Vessels with a maximum length of 250m, beam 50m and draught up to 9m can normally be accommodated.

Perth handles about 100,000 tonnes of cargo a year, mainly agricultural products, sand, chemicals and forest products. The largest vessel received at the port was 94.7m in length in 2009.

6.1.5 Fife Harbours (East Neuk and St Andrews)

St Andrews is a minor harbour used by small fishing vessels (i.e. potters) and recreational craft.

The East Neuk harbours (including Crail, Anstruther, Pittenweem, Saint Monans and Elie) are mostly used by small to medium sized fishing vessels and recreational craft.

6.1.6 Forth Ports

A number of ports and harbour facilities are located within the Firth of Forth, the main ports, harbours, marine terminals and marinas are summarised below:

- Methil – a commercial port handling wood pulp and timber, fertiliser, stone and general cargoes. The maximum size of vessel handled is up to 102m in length, 14.6m beam and 5.5m draught;
- Kirkcaldy – little or no commercial traffic and is mainly used by local fishing vessels;
- Burntisland – small commercial port handling general cargo. The maximum size of vessel handled is 122m in length, beam 16.8m and draught 6.7m;
- Breafoot Gas Terminal – is situated on the north west side of Mortimer's Deep on the north bank of the Firth of Forth. It is a gas tanker terminal serving the Mossmorran petro-chemical complex. The maximum size of vessel handled is draught of 10.8m;
- Inverkeithing – vessels up to 90m in length (approx.) load scrap at the Deep Water Berth and No 1 Berth. Smaller vessels up to 70m load stone at the quarry berth;
- Rosyth –is a commercial port handling general cargo and cruise liners. Additionally there is a Ro-Ro passenger and freight service to Zeebrugge. There is no restriction on length and beam for vessels using the tidal harbour but the maximum permitted draught is 7.8m. It is noted that de-commissioned nuclear submarines are also located in the Royal Dockyard;
- Grangemouth – handles all types of vessels including container vessels, tankers and liquefied petroleum gas (LPG) carriers, with a maximum draught to of 11.7m at the entrance lock at high water;
- Port Edgar – accommodates a yacht marina, with vessels up to 18m in length using the harbour at all states of the tide;
- Hound Point Oil Terminal – is on the western extremity of the Forth Deep Water Channel. The terminal can accommodate tankers of draught 21.64m (springs) and 20.71m (neaps) tides;
- Edinburgh Marina (Granton Harbour) – formerly a small commercial port, now used by leisure craft;
- Leith – the port for Edinburgh and handles cruise liners, general cargoes and dry and liquid cargoes in bulk. It is also a support base for the North Sea offshore industry. The port can accommodate vessels up to 210m in length, beam 30m draught 9.1m, however larger vessels can be accommodated dependant on the high tide;
- Musselburgh – mainly used by recreational vessels up to 18m in length and 2m in draught; and
- Port Seton/Cockenzie – used by small to medium sized fishing vessels and a number of recreational craft.

6.1.7 Harbours South of Phase 1 Developments

A number of small fishing harbours are located along the coastline of East Lothian/Scottish Borders including North Berwick (mainly used by recreational vessels and a small number of fishing boats), Dunbar (used for landing fish and recreational vessels), Cove Harbour (a small fishing harbour) and Eyemouth (a busy fishing harbour, with marina facilities).

6.1.8 Anchorages in the Area

A chart of anchorage areas, which have been identified from charts and the pilot book for the area, are presented in Figure 6.2.

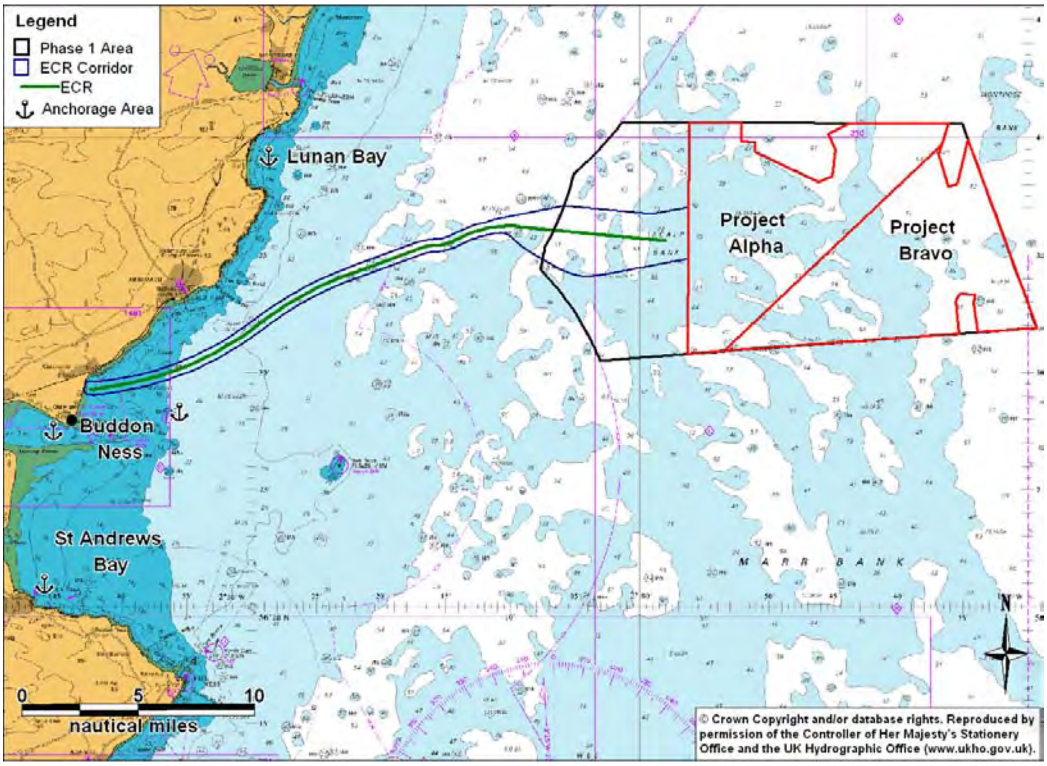

Figure 6.2 Anchorage Areas relative to Phase 1 and ECR Corridor

From north to south the following anchorage areas have been identified:

- Lunan Bay, which lies between Boddin Point and Red Head, is sandy and free from dangers, apart from the rocky ledges off the Point and Head. There is a good anchorage in the bay 1nm east of the ruins of Red Castle in depths of 14m where the seabed type is sand over clay;
- An anchorage is available approximately 4.5nm east of Buddon Ness in the vicinity of the Fairway Light Buoy where the water depth is around 20m;
- There is also an anchorage 0.6nm west south west of Buddon Ness where the water depth is approximately 6m; and
- There is a charted anchorage in St Andrews Bay, approximately 0.8nm from the coast in a water depth of around 8m.

An analysis of anchoring within the 10nm of Phase 1 wind farms is presented in Section 8.6. Plots of vessels anchoring in proximity to the ECR are presented in Appendix A.

6.2 *Navigational Aids*

A plot of the principal navigational aids in the vicinity of the Phase 1 wind farms is presented in Figure 6.3.

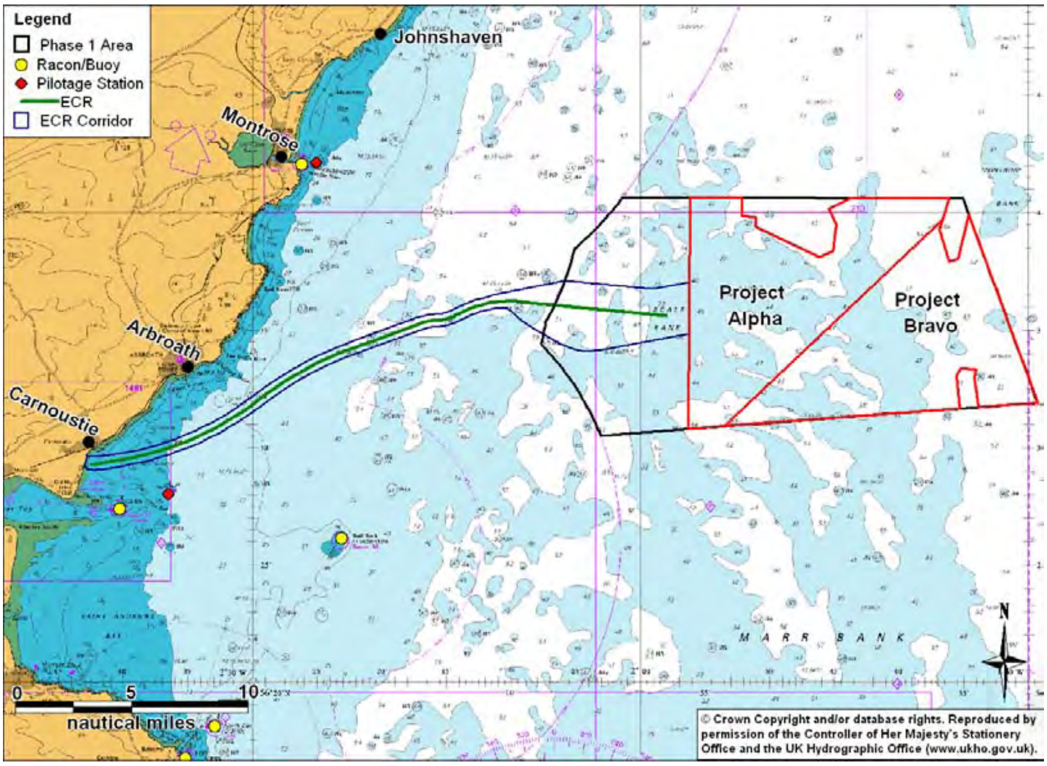

Figure 6.3 Overview of Navigational Aids relative to Phase 1 and ECR Corridor

The main navigational aid /feature in the area is the Racon located on Bell Rock 16nm west by south west of Project Alpha and 17nm west by south west of Project Bravo. In addition, the Montrose Pilotage Station is located 16nm west of Project Alpha, on the approach to Montrose.

6.3 *Sailing Directions*

Sailing directions for the area are presented in the North Sea (West) Pilot (Ref. ix). A plot of the routes for vessels bound from Rattray Head and Isle of May is presented in Figure 6.4.

The arrows are not accurate if superimposed on a chart but they illustrate the general passages used by ships. A description of the route passing from the entrance of the Firth of Tay to Fife Ness (passing the Phase 1 wind farm sites and ECR corridor) is given below.

- (3.147) From a position east of Scurdie Ness (56° 42' N, 2° 26'W) the coastal passage runs south by south west to the vicinity of the Fairway Light Buoy off the entrance to the Firth ofTay, passing (with positions referenced from Whiting Ness (56° 34' N, 2° 33'W)):
  - East by south east of Boddin Point (7.3nm north by north east), thence: east by south east of Red Head (4nm north by north east), a perpendicular cliff of 79m high. Lunan Bay lies between Boddin Point and the north east extremity of Red Head;
  - Thence; east by south east of a pair of former measured distance beacons (1.5nm north by north east) and a single beacon a mile farther south standing the Deil's Head;
  - Thence; east by south east of Whiting Ness and east by south east of an unmarked dangerous wreck (eight cables south by south east);
  - Thence; east by south east of Arbroath (1nm west by south west) and east by south east of Elliot Horses (2.3nm south west), a shoal patch with a depth of 0.2m. Elliot Water, marked by a prominent chimney, reaches the sea on the coast four cables north west of Elliot Horses;
  - Thence; west by north west of Bell Rock (9.5nm south by south east), a reef with a lighthouse on it. There is a shoal patch with a depth of 4.4m 2 cables north and one 2.8 cables south with a depth of 2.5m; and
  - Thence; east by south east of Carnoustie (6nm south west) and east of the Fairway Light Buoy (safe water) (5.5nm south west) off the entrance to the River Tay.
- (3.210) From the vicinity of the Fairway Light-Buoy (56° 28' 3N, 2° 36' 6W) off the entrance to the River Tay, the coastal route is south by south east to Fife Ness, passing (with positions from Fife Ness):
  - East by north east of Saint Andrew Bay (7nm west by north west), with the town of Saint Andrews at its head. The west coast of the bay is fronted by shoal water with depths of less than 5m. Targets and target buoys may be moored off Tentsmuir Sands and there are range beacons ashore;
  - Thence: east by north east of North Carr Rocks (1nm north by north east), which dry. The rock has a prominent beacon (red column on a stone base, globe top-mark, all supported by six metal stays) and lies at the northeast extremity of foul ground extending 1nm north east of Fife Ness. North Carr Light-Buoy (East cardinal) is moored 1nm northeast of North Carr Rocks, which are also covered by the red sector (197 degrees – 217 degrees) of Fife Ness light; and

- Thence: east by north east of Fife Ness, a dark cliff, 10m high, above a rocky foreshore.

Figure 6.4 Routes from Rattray Head to Isle of May (Ref. ix)

6.4 *Wrecks*

Charted wrecks in the vicinity of Phase 1 are presented in Figure 6.5.

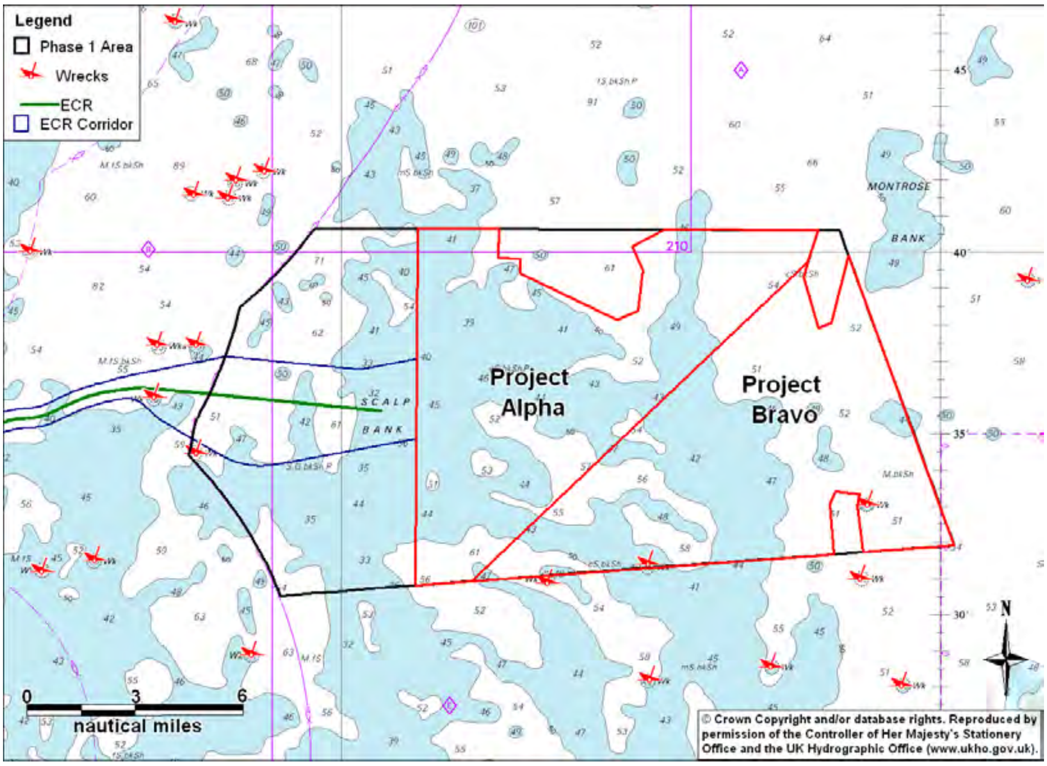

Figure 6.5 Charted wrecks relative to Phase 1 Wind Farms and ECR

Based on admiralty charts of the area, it can be seen that there is one charted wreck within the Project Bravo boundary and two on its southern boundary. There are no wrecks within the boundary of Project Alpha. There is a charted wreck in proximity to the ECR close to the western boundary of Phase 1.

6.5 *Oil & Gas Infrastructure*

The licence blocks in the area of the proposed wind farm sites are presented in Figure 6.6.

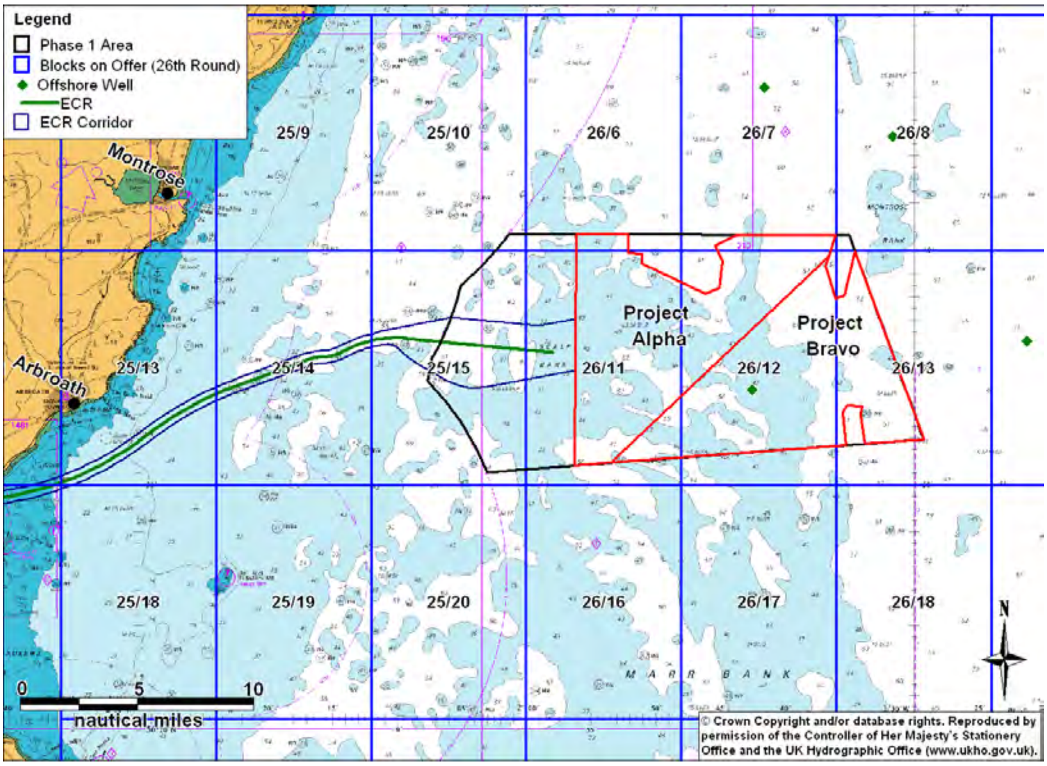

Figure 6.6 Oil & Gas United Kingdom Continental Shelf (UKCS) Blocks, Installations and Licence Areas

The proposed site is largely within UKCS Blocks 26/11, 26/12 and 26/13 which were on offer as part of the 26th round of UKCS offshore licensing. Blocks 26/11 and 26/13 have never been previously licensed and, no offer was received during the latest UKCS round of licensing.

One historical exploration well is located within Project Bravo in the previously licensed UKCS block 26/12, originally drilled by Cluff Oil Plc. in October 1985. The second closest historic exploration well is 5.2nm north by north east of Project Bravo and was drilled by Mobil North Sea Ltd in October 1992. Both exploration wells were plugged and abandoned.

The nearest existing offshore surface installation is the Curlew Floating, Production, Storage and Offloading (FPSO) unit 96nm east of Project Alpha and 95nm east of Project Bravo. There are no oil and gas installations in proximity to the ECR.

6.6 *Other Navigational Features*

The other main navigational features in the area are shown in Figure 6.7.

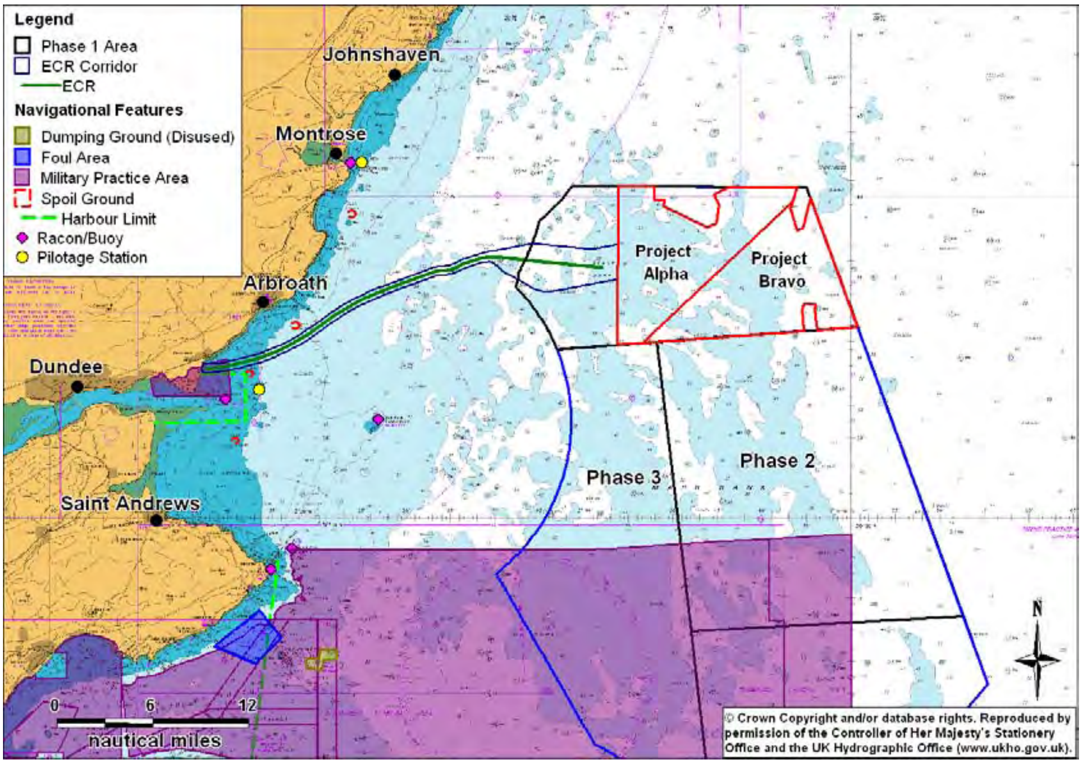

Figure 6.7 Military Practice Areas and other Navigation Features in the Area

Note that whilst the south-east corner of Project Bravo previously overlapped with the Practice and Exercise Area (PEXA) D609, this site has now been completely withdrawn from use. The ECR intersects part of the Barry Buddon Military PEXA D604 (weapons firing and demolition) off Buddon Ness on the northern side of the River Tay.

The only aggregate dredging licence in Scotland was located within the inner Firth of Forth; however the ten year lease between Westminster Gravels Ltd and The Crown Estate ended in January 2011. Therefore the impact of the Phase 1 developments on dredging activities was screened out of the NRA. Any historic aggregate licence areas within the Firth of Forth or Firth of Tay which could be reopened in the future are anticipated to be a sufficient distance from the Firth of Forth zone not to create an effect.

There are no active or disused marine disposal sites within the Project Alpha or Project Bravo sites. There are several currently licensed sea disposal sites in coastal waters inshore of the Project Alpha or Project Bravo sites receiving the material arising from port and harbour dredging activity. There is one disposal site inshore that falls just within the ECR corridor however no further detail is available at present in respect to the activities at this site.

6.6.1 Marine Environmental High Risk Areas

Marine Environmental High Risk Areas (MEHRAs) are areas that have been identified by the UK Government, as areas of environmental sensitivity and at high risk of pollution from ships. The UK Government expects mariners to take note of MEHRAs and either keep well clear or, where this is not practicable, exercise an even higher degree of care than usual when passing nearby.

MEHRAs are located within 30nm of Phase 1 and 19nm south of the ECR along the cliffs of the Isle of May and at Anstruther, as presented in Figure 6.8. Both MEHRAs have been designated on wildlife, landscape and geological grounds.

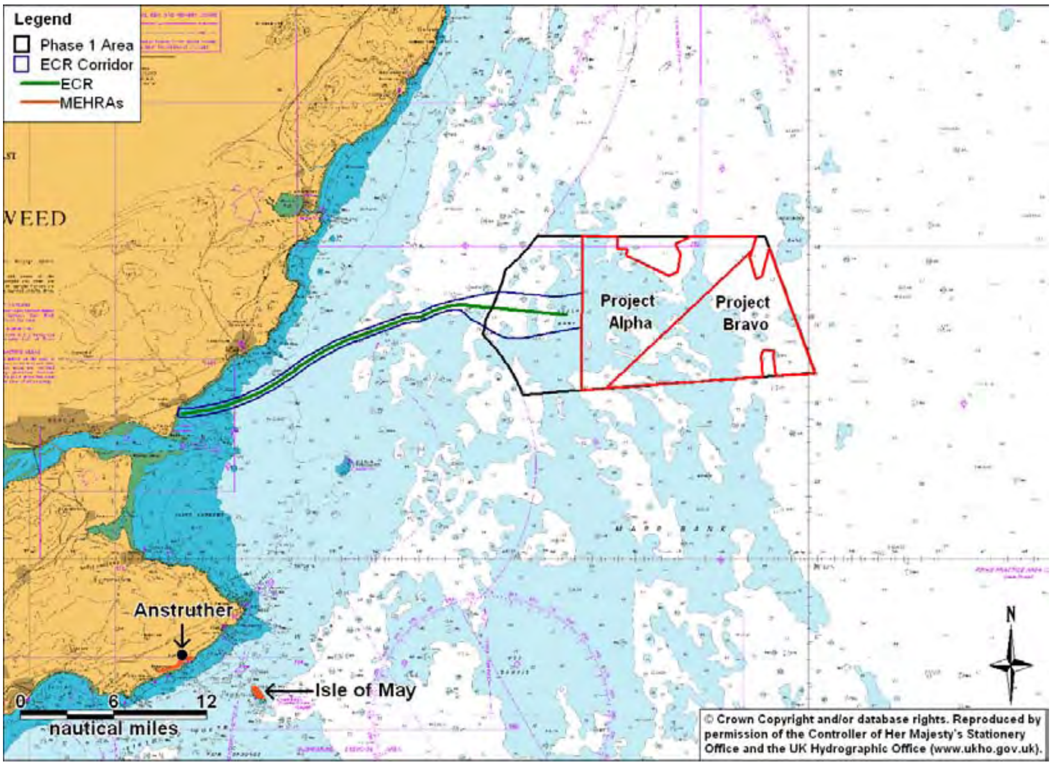

Figure 6.8 MEHRAs relative to Phase 1 wind farms

6.7 *Metocean Data*

6.7.1 Introduction

This section presents a summary of the metocean data for the area of the Seagreen Project which has been used as an input to the risk assessment.

It should be noted that site specific metocean data (as presented in Chapter 7 of the ES) became available during the course of undertaking the NRA. However, a decision was made to use the standard data set described in this section for the collision risk modelling rather than the site specific data as it would not notably influence the outcome the models.

According to the Admiralty Sailing Directions (Ref. ix), the west North Sea region enjoys a generally mild climate. Winds blow from between the south and northwest most usually, and are often fresh or strong. Gales are more common in the winter months, although they still may occur during the summer.

Rainfall is not considerable, and there is little variation throughout the year. It is frequently cloudy throughout the year; however, the winter months are more susceptible to overcast skies. Fog (or haar) occasionally affects the east cost of the UK, particularly in the north.

Metocean data recorded at Phase 1 and the surrounding area is presented from the Wind and Wave Frequency Distributions for sites around the British Isles Offshore Technology Report (Ref. x).

6.7.2 Wind

The wind data for the site has been taken from recordings made approximately 4.3nm north Project Alpha (56° 44’ 52.8”N, 001° 34’ 58.8”W). The wind direction distribution is presented in Figure 6.9. It can be seen that the wind direction is predominantly from a south westerly direction.

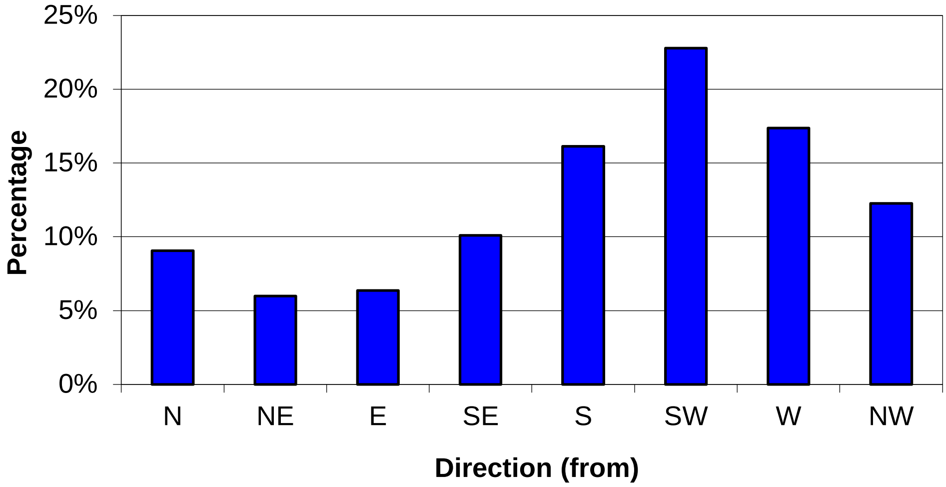

Figure 6.9 Average Annual Wind Direction Distribution (Ref. x)

It was also noted that easterly or north easterly winds can result in a very large swell near to the Phase 1 sites. This may result in poor sea conditions in the proposed wind farm area, for example when accessing the wind farm for operations/maintenance and emergency response.

6.7.3 Visibility

Historically, visibility has been shown to have a major influence on the risk of ship collision. The annual probability of visibility less than 1km for the UK North Sea is approximately 0.03, i.e., approximately 3% of the year.

Sea haar and poor visibility can occur in the area of Phase 1 during an easterly sea breeze and this is most common during March to May.

6.7.4 Wave Height

The wave height data taken from recordings made approximately 4.3nm north of Project Alpha is presented below.

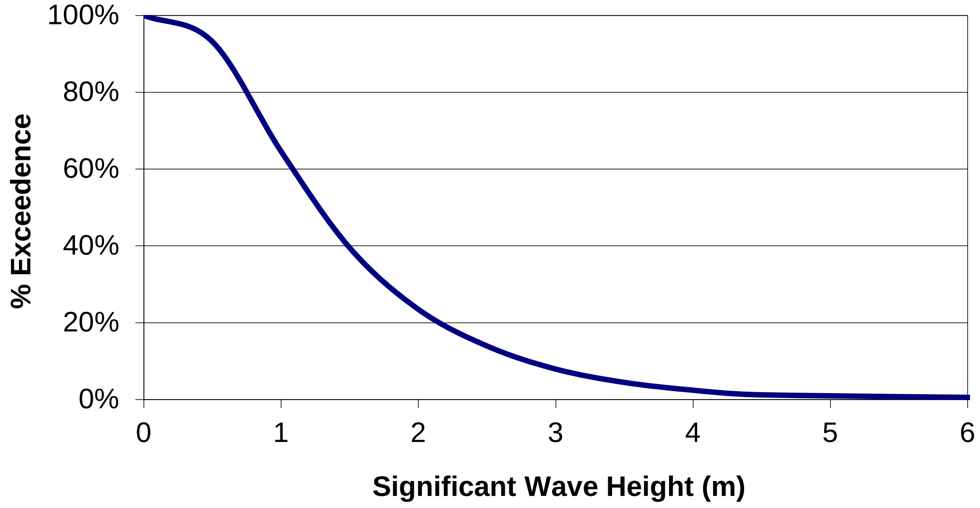

Figure 6.10 Average Wave Height (Ref. x)

The large majority of the wave heights recorded were under 4m, with approximately 4% of the year recording a significant wave height over 4m.

6.7.5 Tide

A description of the tidal streams in the general area is provided below (Ref. ix):

> *"The offshore stream runs generally north and south from Rattray Head to Bell Rock.*
>
> *South of Bell Rock, clear of the land and in the outer part of Firth of Forth the tidal streams are weak, spring rate at 1 knot, but run in various directions throughout the tidal cycles."*

Chart Datum and Ordnance Datum for the Phase 1 wind farms based on values recorded at Montrose are presented below.

Table 6.1 Chart Datum and Ordnance Datum Figures for Phase 1 Sites

Tidal Level	Height above Chart Datum
Mean High Water Neaps (MHWN)	3.8m
Mean High Water Springs (MHWS)	4.9m
Mean Low Water Springs (MLWS)	0.8m
Mean Low Water Neaps (MHWN)	1.8m

Figure 6.11 presents the locations of charted tidal diamonds relative to Phase 1.

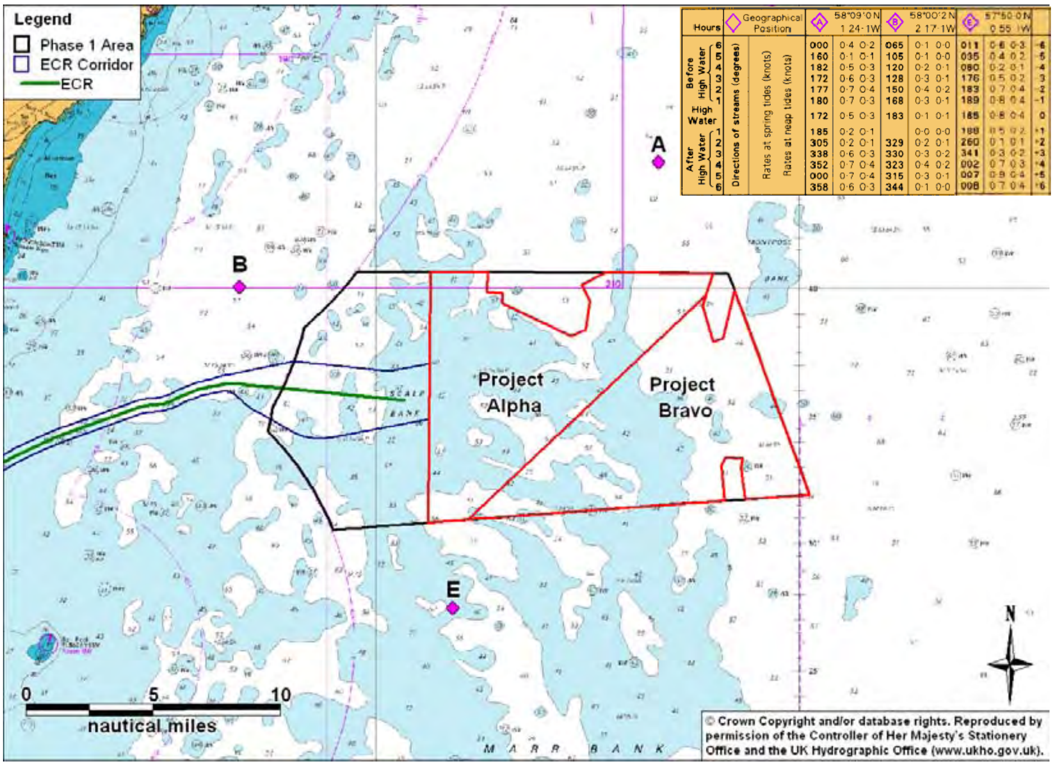

Figure 6.11 Tidal Stream Data for Phase 1 Sites (Tide Points 'A, B and E')

Admiralty Chart 1407 (Tidal Diamond 'E' approximately 3.4nm south and 6.5nm south by south west of Project Alpha and Project Bravo, respectively) indicates that currents in the area are set in a generally west by south by south west direction on the ebb and east by north by north east direction on the flood, with a peak spring tidal rate of 1.2 knots and peak neap rate of 0.6 knots.

7. MARITIME INCIDENTS

7.1 *Introduction*

This section reviews maritime incidents that have occurred in the vicinity of the proposed Phase 1 wind farms in the ten year period from 2001 to 2010.

A review of maritime incidents in proximity to the ECR is presented in Appendix A.

The analysis is intended to provide a general indication as to whether the area of the Phase 1 wind farms is currently a low or high risk area in terms of maritime incidents. If it was found to be a particular high risk area for incidents, this may indicate that the developments could exacerbate the existing maritime safety risk in the area.

Data from the following sources has been analysed:

- Marine Accident Investigation Branch (MAIB)
- Royal National Lifeboat Institution (RNLI

It is noted that the same incident may be recorded by both the sources.

7.2 *MAIB*

All UK commercial vessels are required to report accidents to MAIB. Non-UK vessels do not have to report unless they are in a UK port or are in 12nm territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report accidents to MAIB.

The locations[1] of accidents, injuries and hazardous incidents reported to MAIB within 10nm of the Phase 1 boundary for the last ten years between January 2001 and December 2010 are presented in Figure 7.1, colour-coded by type.

[1] MAIB aim for 97% accuracy in reporting the locations of incidents.

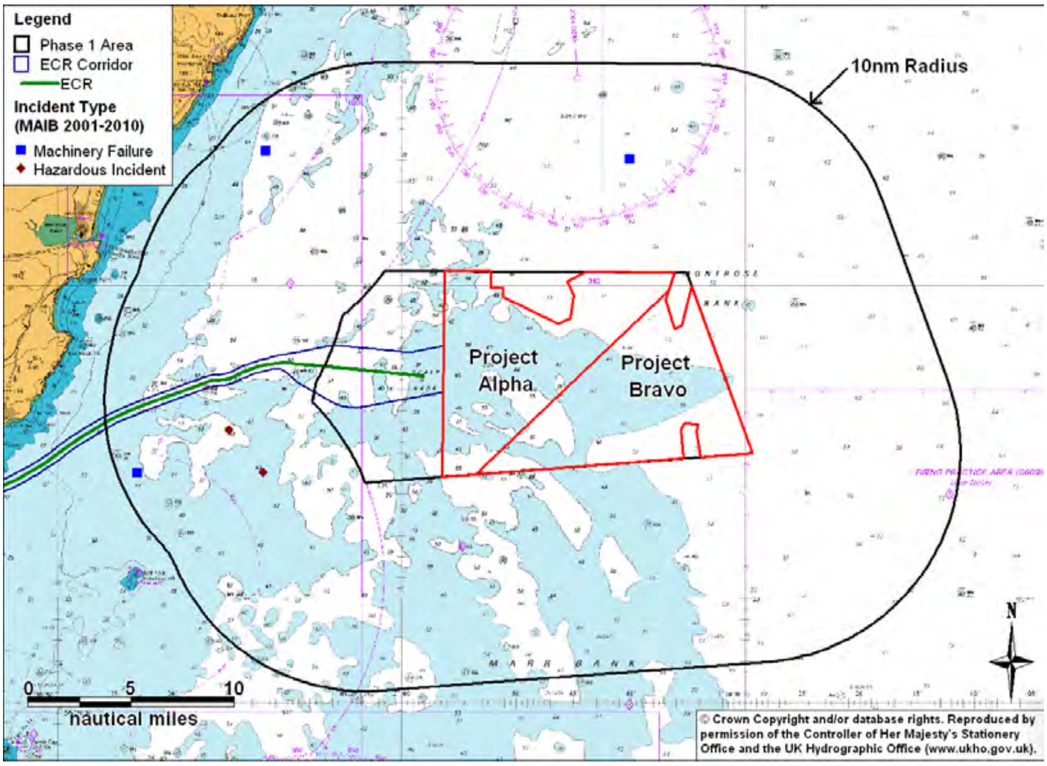

Figure 7.1 MAIB Incident Locations by type within 10nm of Phase 1 Wind Farms

A total of five unique incidents involving six vessels were reported in the area within 10nm of Phase 1, corresponding to an average of 1 every two years.

No incidents were recorded within the boundaries of Project Alpha or Project Bravo. The closest incident to the Phase 1 wind farms occurred approximately 5nm north of Project Alpha in January 2010 when a container ship had a machinery failure in rough sea conditions (Beaufort Force 4-6). The incident is summarised in more details below (Ref. xi):

- *"Feeder container ship was on passage using the shaft generator to provide electrical power. A wiring fault in the main supply breaker caused the shaft generator to trip and electrical power was lost. One of two generators started automatically but at the same time a fault developed in the oil cooler. The oil cooler served both generators and the fault prevented them from being run. The vessel was able to return to port to carry out repairs".*

7.3 *RNLI*

Data on RNLI lifeboat responses within 10nm of the Phase 1 wind farms in the ten-year period between 2001 and 2010 have been analysed. A total of nine launches to 11 separate incidents were recorded by the RNLI (excluding hoaxes and false alarms).

Figure 7.2 presents the geographical location of incidents colour-coded by casualty type.

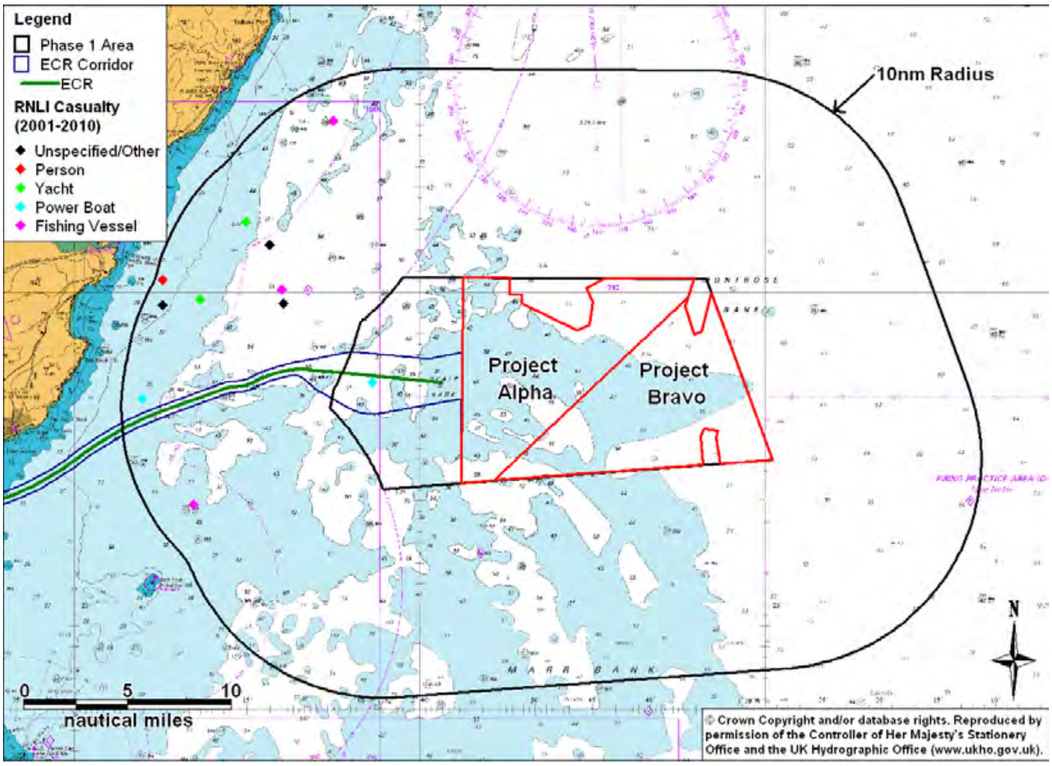

Figure 7.2 RNLI incidents by Casualty Type within 10nm of Phase 1 wind farms

As was the case with the MAIB data, no incidents were recorded within the boundaries of Project Alpha or Project Bravo within the 10 years analysed. The closest incident was recorded approximately 4.2nm west of Project Alpha in the western part of Phase 1. The incident involved a large power boat in April 2010. No cause was given for the incident; however the Montrose ALB assisted the vessel.

The overall distribution by casualty type is summarised in Figure 7.3.

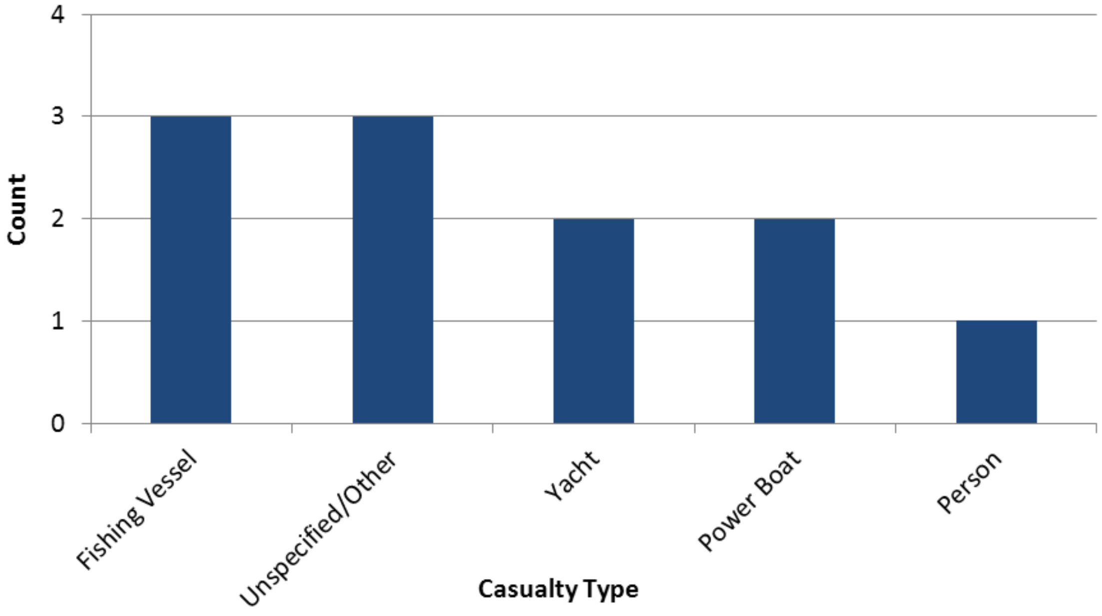

Figure 7.3 RNLI Incidents by Casualty type within 10nm of Phase 1 (2001-2010)

The most common vessel types involved were fishing vessels (3) and recreational craft (yachts (2) and power boats (2)). A chart of the incidents colour-coded by cause is presented in Figure 7.4.

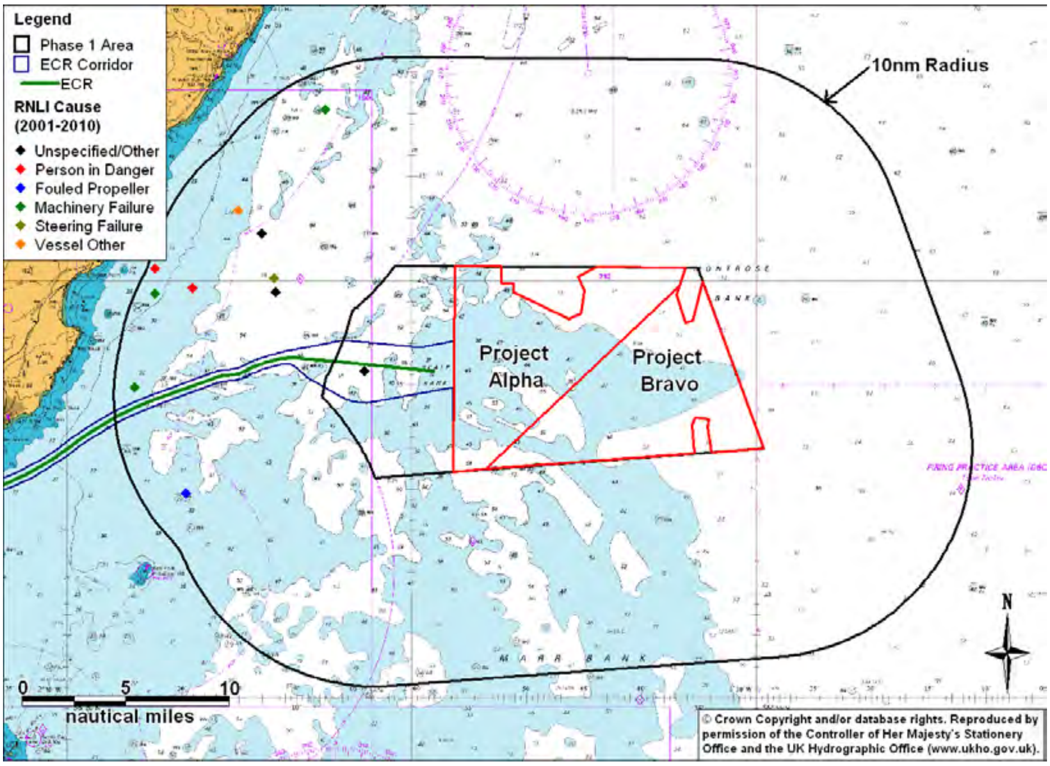

Figure 7.4 RNLI Incidents by Cause within 10nm of Phase 1 Wind Farms

The reported causes are summarised in Figure 7.5.

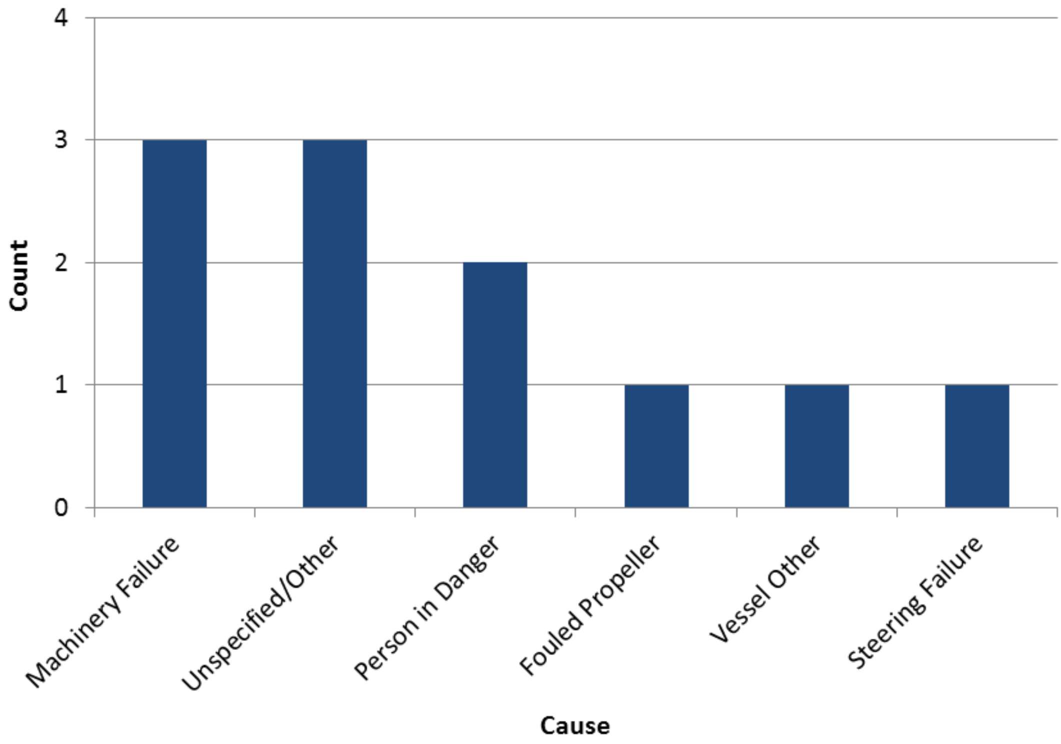

Figure 7.5 RNLI Incidents by Cause within 10nm of Phase 1 Wind Farms (2001-2010)

Of the incidents which had a specified cause, the two main causes were machinery failure and person in danger, which together accounted for 45% of incidents. All the incidents within 10nm of the Phase 1 wind farms were responded to by either Montrose or Arbroath ALB.

7.4 *Conclusions*

Based on the review of incidents, it can be seen that the area within and around the Project Alpha and Project Bravo sites has experienced a relatively low rate of accidents in recent years. Most incidents in the area tend to occur in more coastal area, i.e. in and around Arbroath and Montrose.

8. MARITIME TRAFFIC SURVEYS

8.1 *Introduction*

Maritime shipping traffic surveys of the Phase 1 area were carried out to collect AIS and non-AIS radar track data on vessel movements. By using both AIS and radar, it ensures that the majority of vessels are picked up in the survey. This section summarises the results of the maritime traffic surveys.

The maritime traffic survey data and coastal AIS data collected as part of the FTOWDG relative to the ECR are presented in Appendix A.

8.2 *Survey Details*

The main maritime traffic surveys were carried out from *EEMS* and *Highland Eagle* which recorded AIS (and non-AIS radar) shipping data for the Phase 1 area. The vessel based surveys took place during 14 days in March 2011 (*EEMS*) and 26 days in June/July 2011 (*Highland Eagle*); with a combined total of 40 days data being collected.

8.2.1 EEMS Winter Survey

AIS and radar (non-AIS) data were recorded from a dedicated survey vessel (*EEMS*) which was operating from a holding position within the centre of Phase 1 from 03:22 hours on Saturday 12 March 2011 to 02:44 hours on Saturday 26 March 2011 (14 days). An image of this vessel is presented in Figure 8.1.

Figure 8.1 Survey Vessel *EEMS*

Full details of the *EEMS* survey are presented in a separate report prepared by Anatec (Appendix E).

8.2.2 Highland Eagle Summer Survey

A second shipping survey was carried out from the *Highland Eagle* offshore support/drilling vessel. The vessel was on site and commenced the survey on Monday 20 June 2011 and departed the site at 18:00 hours on Tuesday 21 June before returning to survey for the period 23 to 29 June (the vessel left at 09:00 hours to crew change in Aberdeen). Following the crew change the vessel was on site from the 1 July to 20:00 hours on the 10 July and then returned for 3 hours on the 12 July to complete the surveying at 15:00 hours on the 21 July. It is noted that in total coverage of the survey area was achieved for 26 days and 17 hours.

The objective of the survey was to collect data on vessel movements in the area during the summer period and to collect further shipping data. An image of this vessel is presented in Figure 8.2.

Figure 8.2 Survey Vessel *Highland Eagle*

Full details of the *Highland Eagle* survey are presented in a separate report prepared by Anatec (Appendix F).

8.2.3 Survey Vessel Movements

The area of operation of the two main survey vessels (*EEMS* and *Highland Eagle*) during the Phase 1 maritime traffic surveys is presented in Figure 8.3.

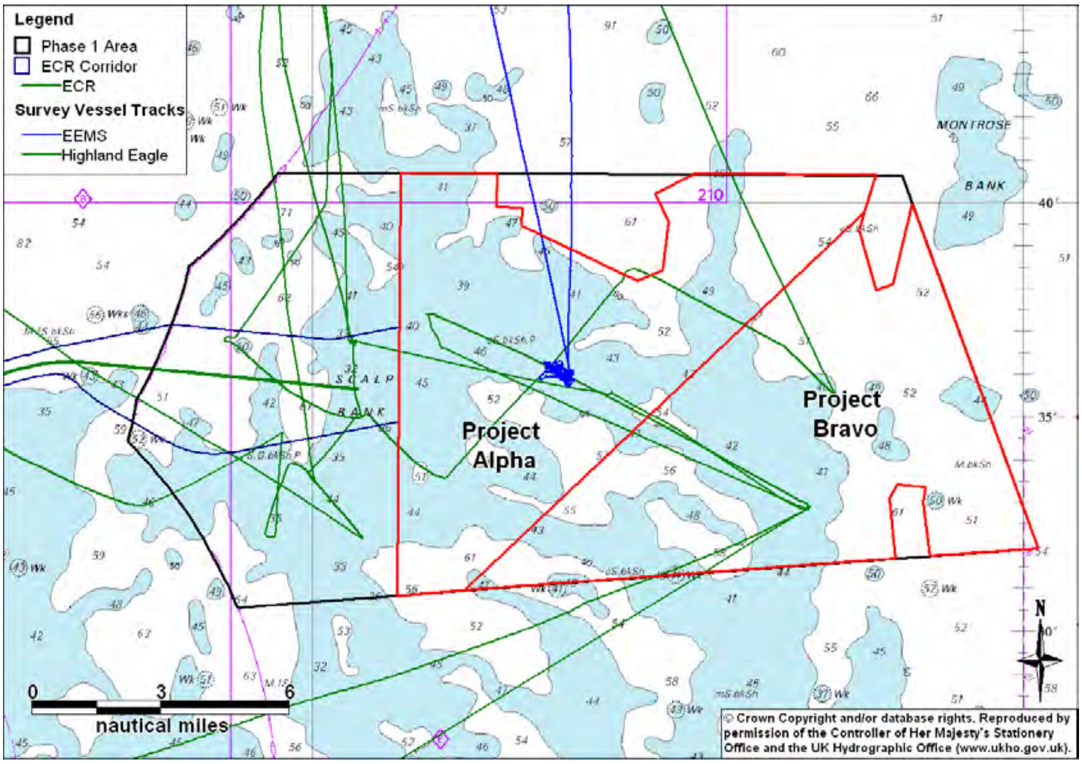

Figure 8.3 Tracks of Survey Vessels relative to Phase 1 Wind Farms

As the vessel *EEMS* was a dedicated survey vessel, a holding position was maintained within the centre of Phase 1 during the duration of survey.

The tracks of *Highland Eagle* show that the vessel was engaged in operations across the Phase 1 area over the 26 days of data collected.

The non-AIS radar data was recorded from the automatic radar plotting aid (ARPA) systems onboard the survey vessels, with radar data logging equipment set-up to record each target acquired on radar. The target positional data was recorded from a feed from the radar to the serial port of the survey laptops.

The radar surveys were conducted during periods when the bridge was manned. The radar range varied based on weather and sea conditions, however visual target details were logged in survey log forms and vessels were generally tracked over 6nm from the survey vessels and some targets beyond 15nm.

8.2.4 Clupea Forth Zone Survey

Additional survey data was collected from the ornithology and marine mammals survey vessel *Clupea* from 30 November 2010 to 28 February 2011 whilst operating within the outer Firth of Forth and Round 3 development zone.

This AIS data was processed and validated against the dedicated AIS and radar survey data recorded during 2011 to provide a comprehensive overview of shipping activity in the area.

8.3 *Survey Analysis*

The *EEMS* and *Highland Eagle* survey data is analysed within 10nm of Phase 1 in terms of:

- Vessel Type;
- Busiest Day;
- Draught;
- Length; and
- Speed.

It is noted that survey vessels operating within the area during the maritime traffic surveys were excluded from the analysis.

Plots of the tracks recorded from *EEMS* and *Highland Eagle* during the survey period are presented in Figure 8.4 and Figure 8.5 respectively colour-coded by vessel type.

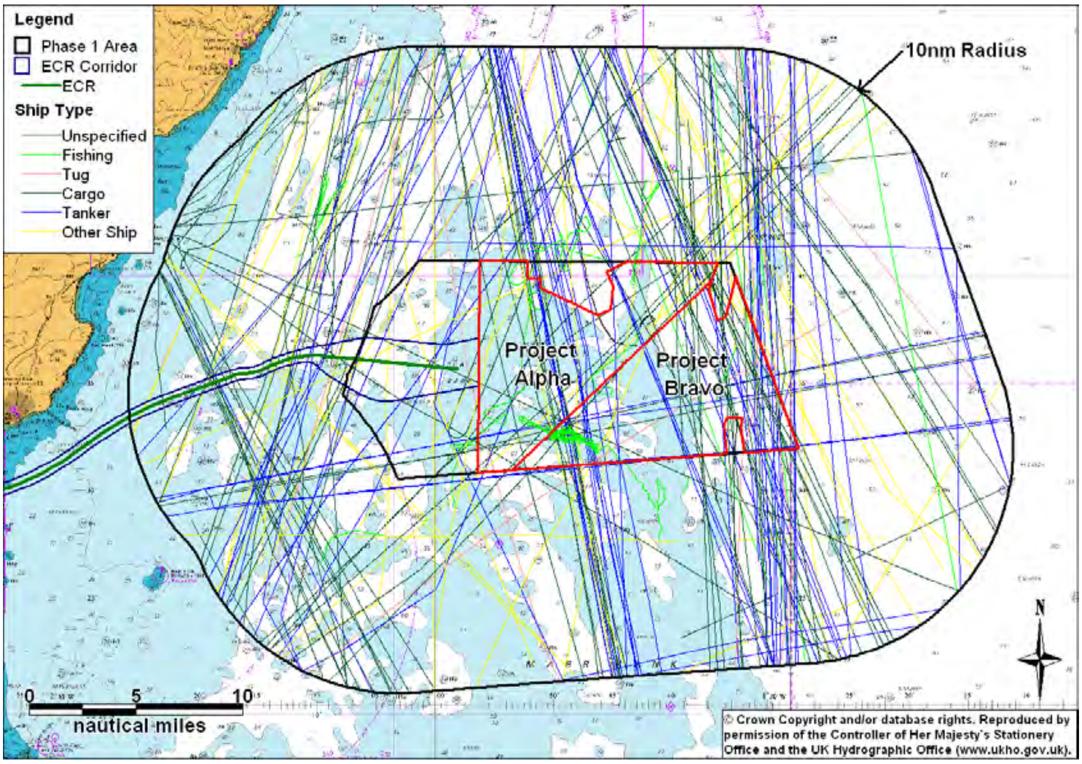

Figure 8.4 *EEMS* Combined AIS and Radar Tracks by Type – All Vessels (14 days)

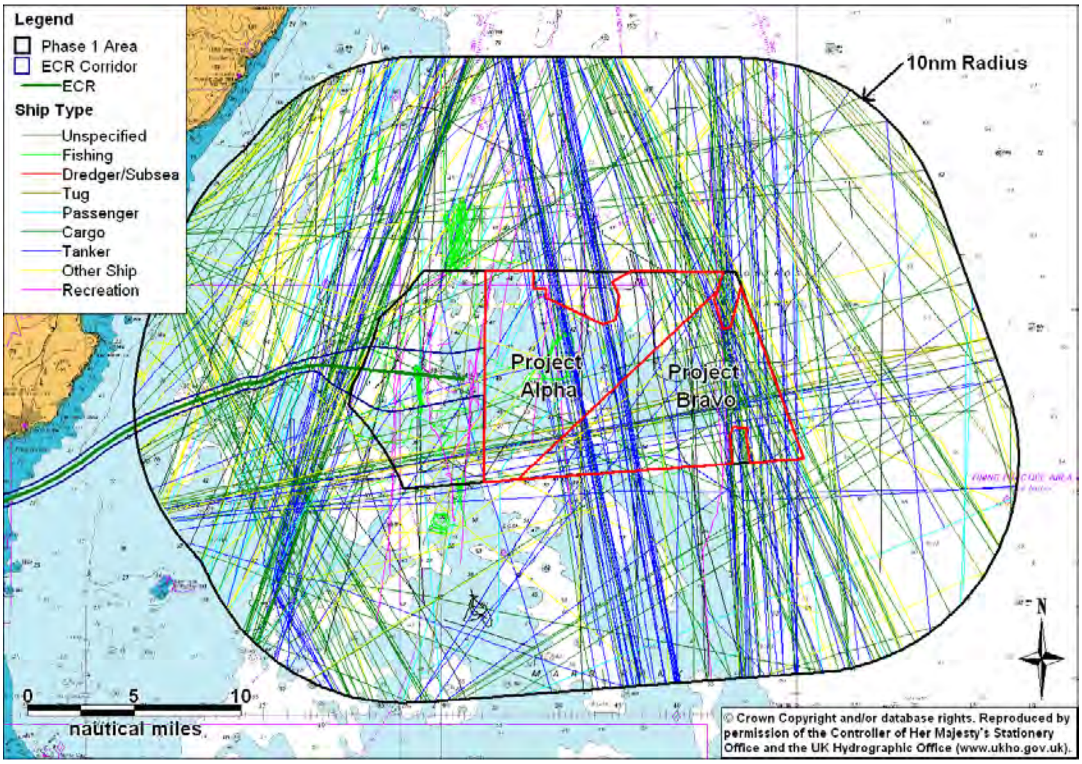

Figure 8.5 ***Highland Eagle*** **Combined AIS and Radar Tracks by Type – All Vessels (26 days)**

In total there was an average of 16 vessels per day passing within 10nm of Phase 1 from the winter survey and 14 vessels per day recorded during the summer survey.

To put the traffic volumes into a daily context, the tracks recorded on the busiest days recorded from the two survey vessels are presented in Figure 8.6 and Figure 8.7.

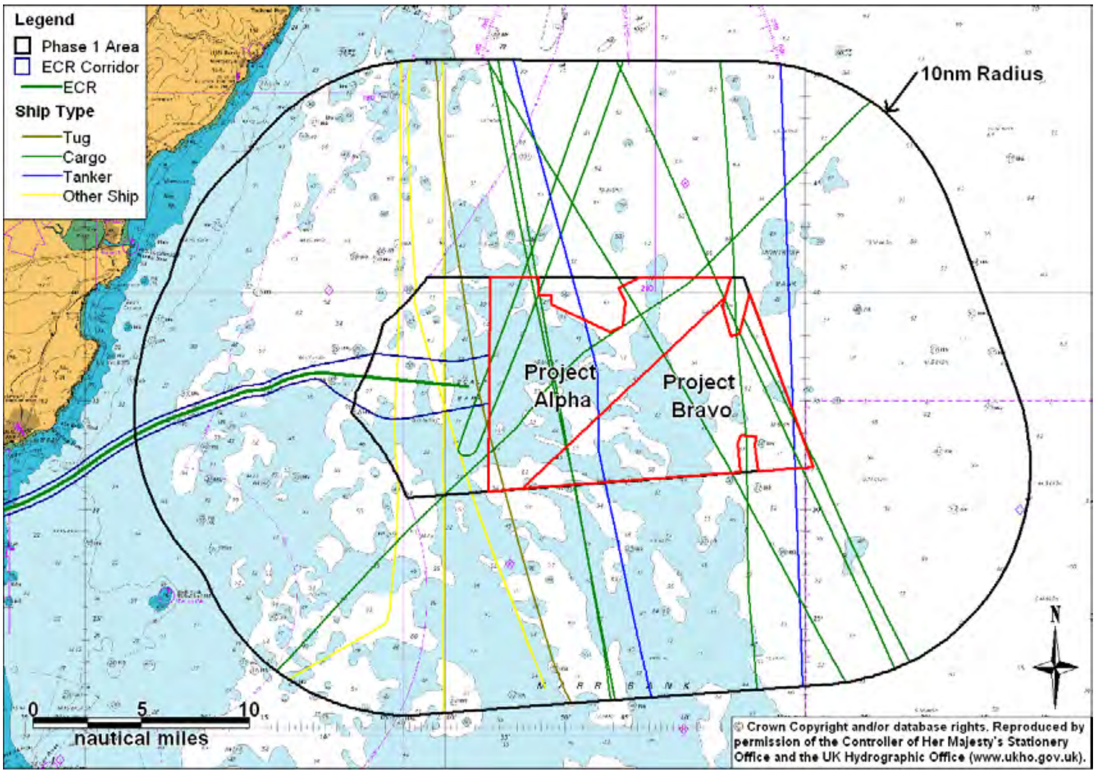

Figure 8.6 **Vessels Intersecting Phase 1 - *EEMS* Busiest Day (13 March 2011)**

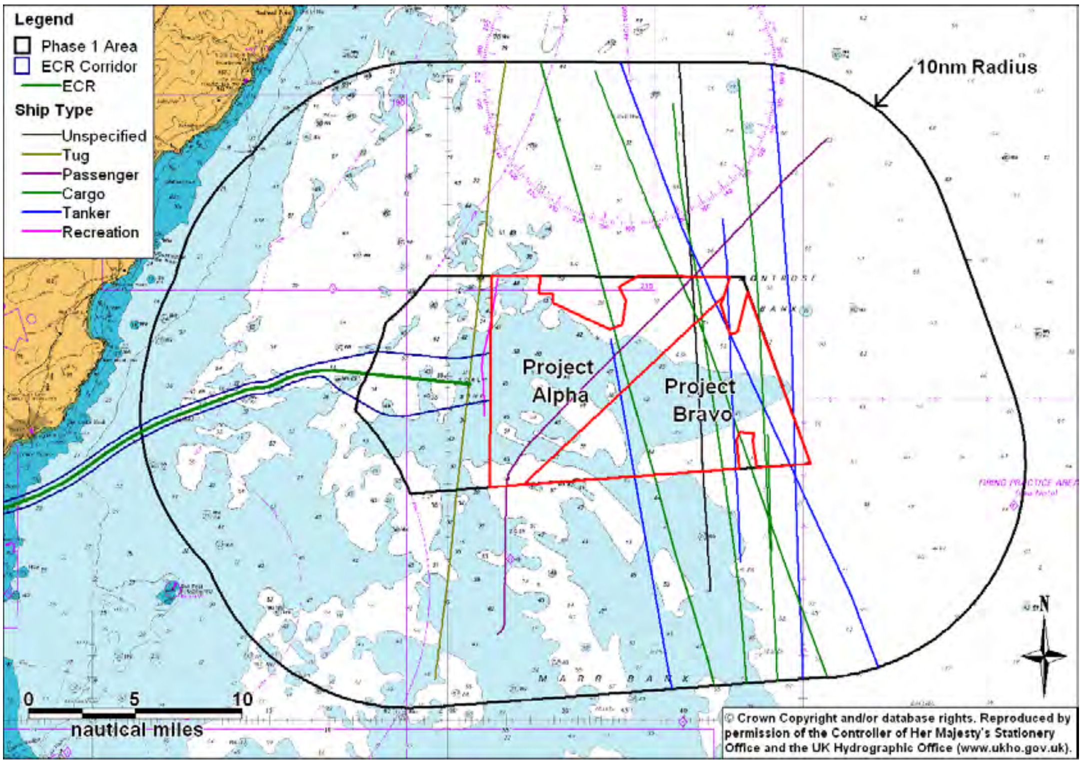

Figure 8.7 Vessels Intersecting Phase 1 - Busiest Day *Highland Eagle* (24 June 2011)

The breakdown of vessel type within 10nm of Phase 1 is presented in Figure 8.8. This considers all vessels recorded during the two survey periods presented above (40 days), but excludes unspecified vessels which represented 6% of vessel tracks.

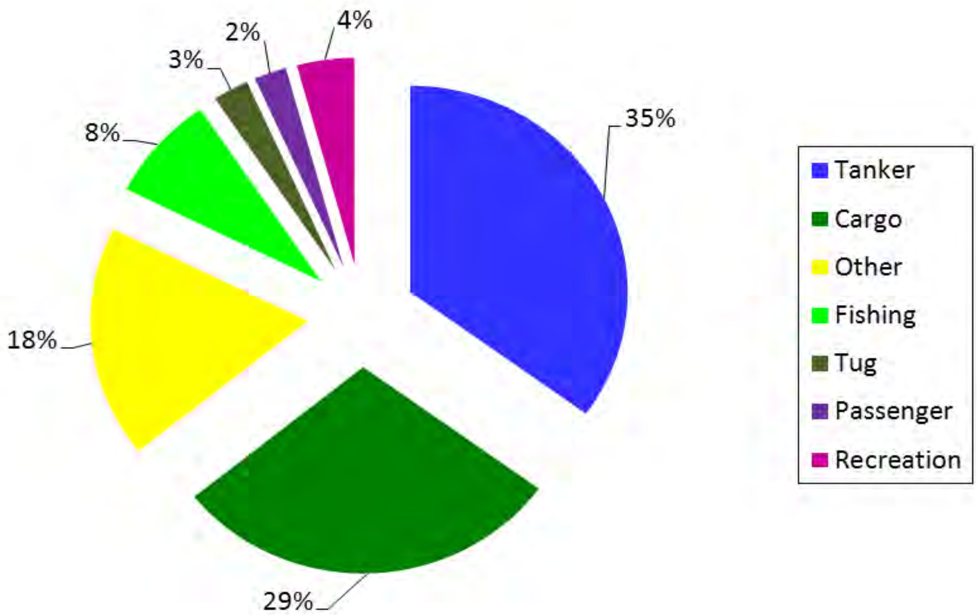

Figure 8.8 Vessel Types identified during the Combined Surveys

Tankers were the most common vessel type within the area comprising 35% of traffic, followed by cargo vessels contributing 29%. Other vessels made up 18% and were mainly offshore support vessels for North Sea oil and gas operations.

The distribution of vessels by draught (excluding those which did not specify a draught) for the combined survey period is presented in Figure 8.9.

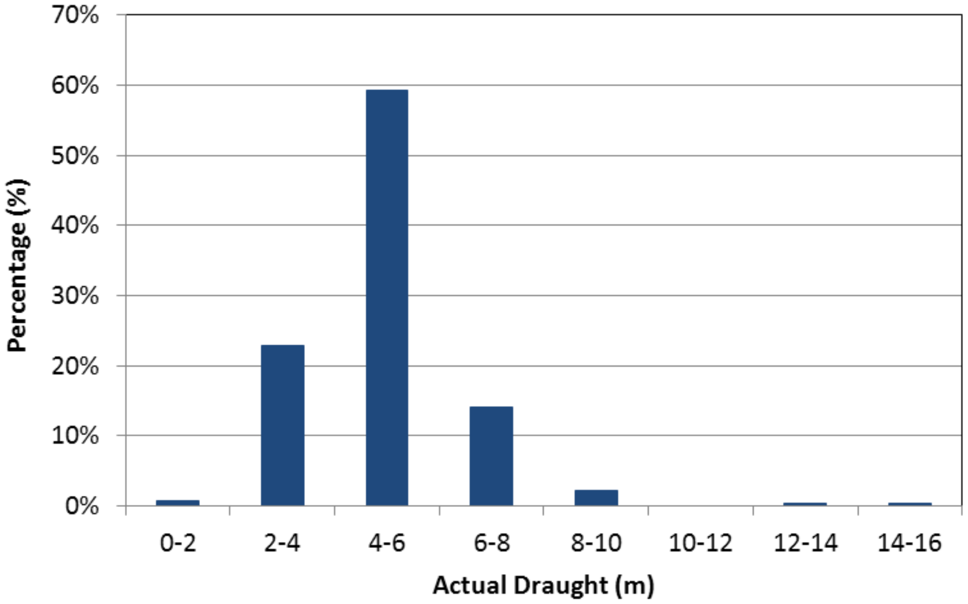

Figure 8.9 Distribution of Vessels by Actual Draught for the Combined Surveys

The average draught recorded over the combined survey periods was 5.1m. It can be seen that the majority of vessels had draughts between 4m and 6m (59%).

A plot of the tracks colour-coded by draught for the combined survey is presented in Figure 8.10.

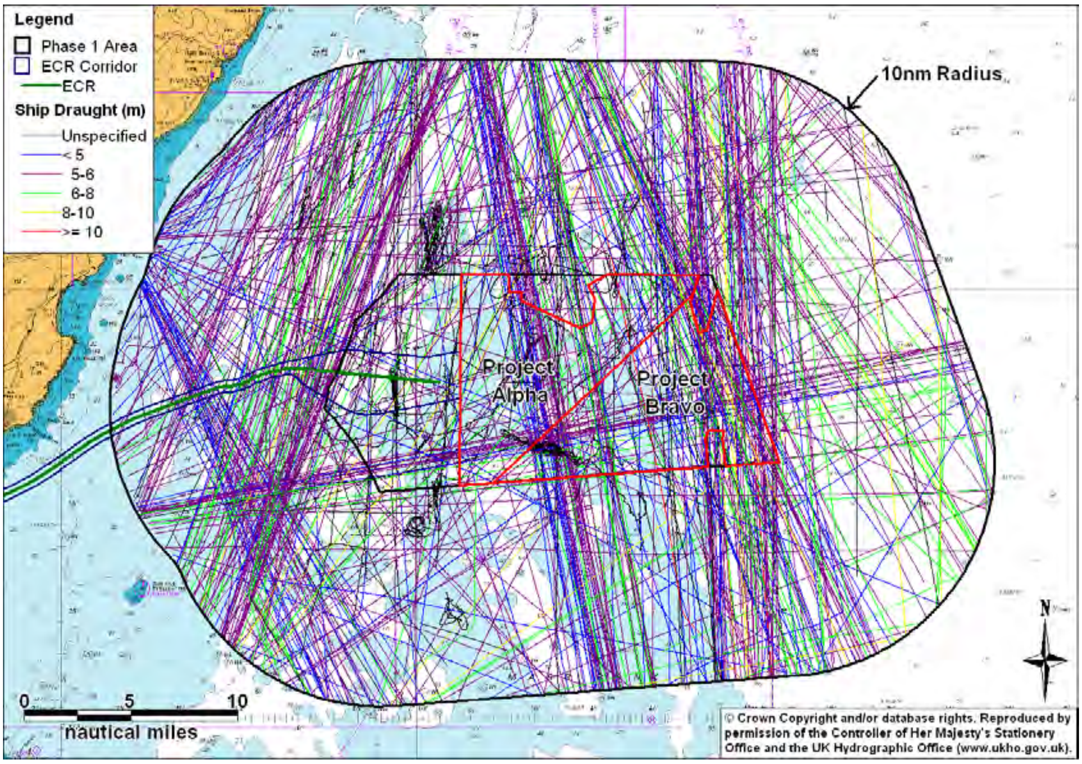

Figure 8.10 Combined Survey Tracks by Ship Draught

The deepest draught vessel recorded was *Hanne Knutsen* which was headed south through the eastern corner of Project Alpha and the centre of Project Bravo to Teesport. This is a 123,581 Dead Weight Tonnage (DWT) Crude Oil Tanker, with draught broadcast at 16m. An image of *Hanne Knutsen* is presented in Figure 8.11.

Figure 8.11 Crude Oil Tanker *Hanne Knutsen*

The distribution of vessels by length (excluding those which did not specify a length) for the two combined surveys is presented in Figure 8.12.

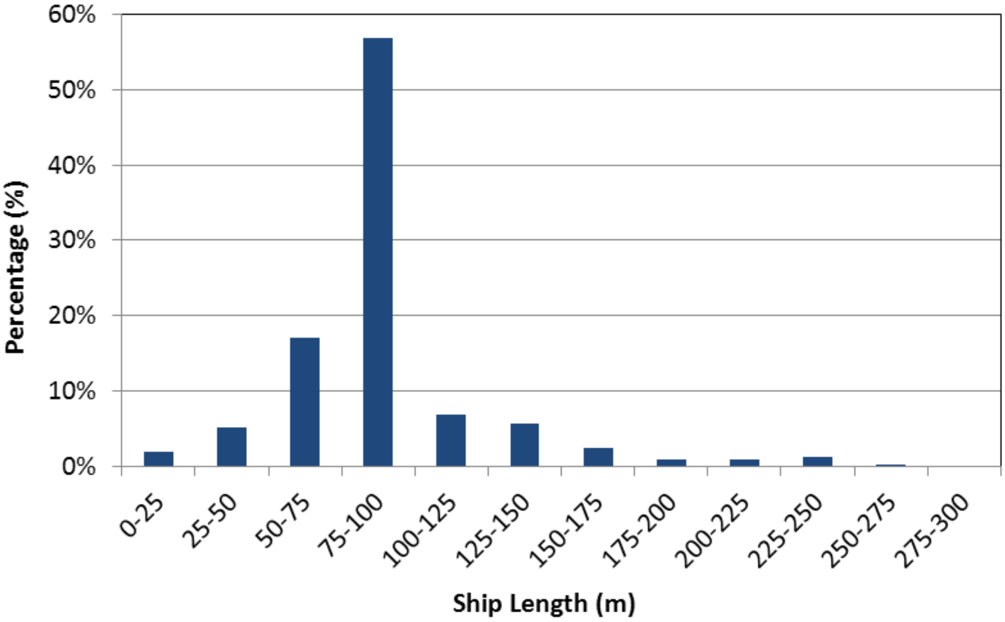

Figure 8.12 Distribution of Vessels by Length for the Combined Surveys

The average length of vessels recorded over the combined survey periods was 91m. It can be seen that a large portion of vessels had lengths between 75m and 100m (57%).

A plot of the tracks colour-coded by length for the combined survey period is presented in Figure 8.13.

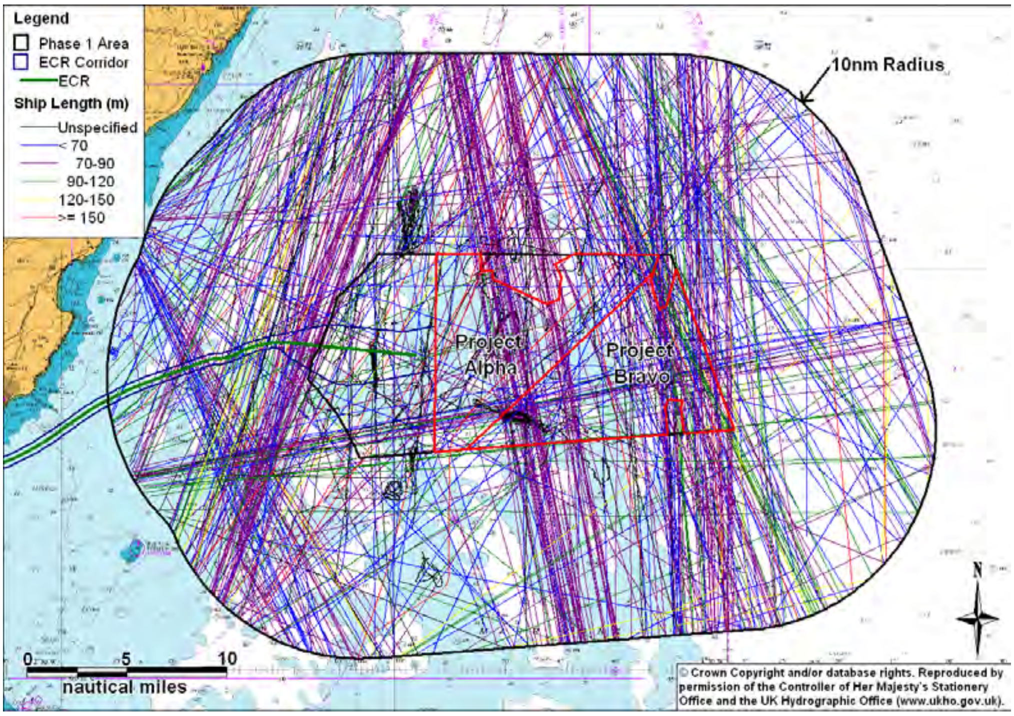

Figure 8.13 Combined Survey Tracks by Ship Length

The longest vessel recorded intersecting Phase 1 was the passenger vessel *Crown Princess* at 289m, recorded intersecting the north west section of Project Alpha headed to Invergordon. This vessel is 50m wide at the beam and broadcast a draught of 8.6m.

Figure 8.14 Passenger Cruise Ship *Crown Princess*

Figure 8.15 presents the distribution of average speeds for vessels recorded during the maritime traffic surveys.

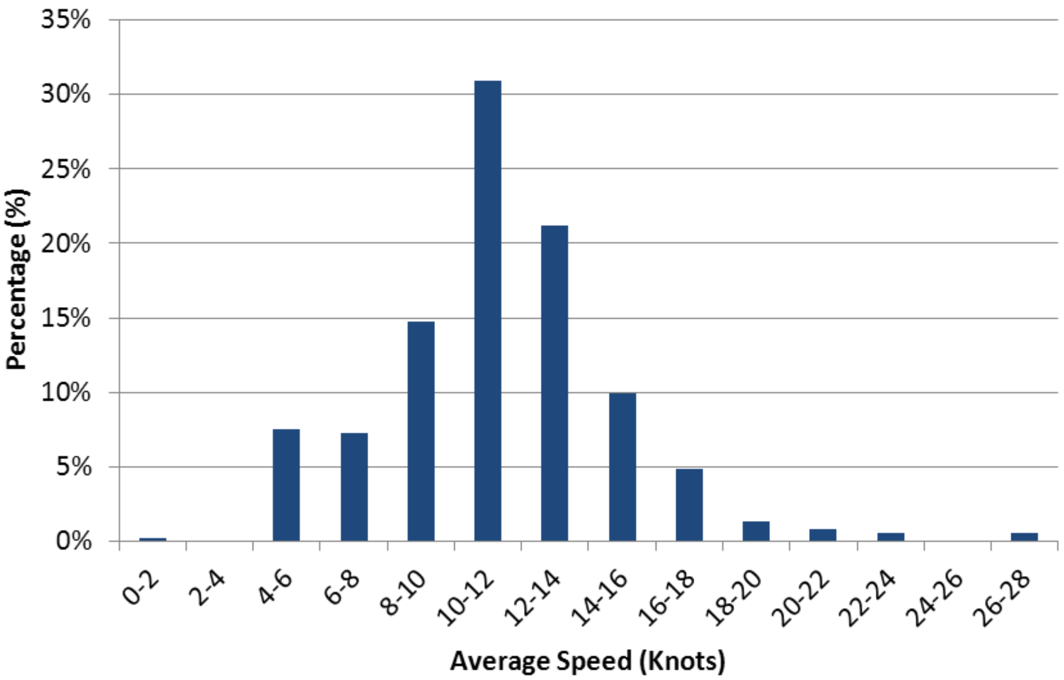

Figure 8.15 Average Speed Distributions for Combined Surveys

The average speed was 9.4 knots. The fastest vessel tracked within Phase 1 was a non-AIS recreation vessel travelling at 25 knots.

The fastest AIS target was the *Porth Dinllaen* wind farm support and crew transfer vessel recorded at an average speed of 25 knots headed southbound to Eyemouth intersecting the north western part of Project Alpha.

8.4 *Site-Specific Review for Project Alpha*

This section presents detailed plots of the vessel tracks which intersected Project Alpha during the 40 day *EEMS* and *Highland Eagle* survey.

Charts of the main vessel types passing through Project Alpha are presented in the following sub-sections. The analysis of data includes the following:

- Intersecting Vessels (all types) (Figure 8.16);
- Tankers (Figure 8.17);
- Cargo Vessels (Figure 8.18);
- Passenger Ships (Figure 8.19);
- Other Vessels (Figure 8.20);
- Fishing Vessels (Figure 8.21); and
- Recreational Vessels (Figure 8.22).

8.4.1 Intersecting Vessels (All Types)

Figure 8.16 presents the tracks of all vessels which were identified as passing through Project Alpha during the combined 40-day survey period.

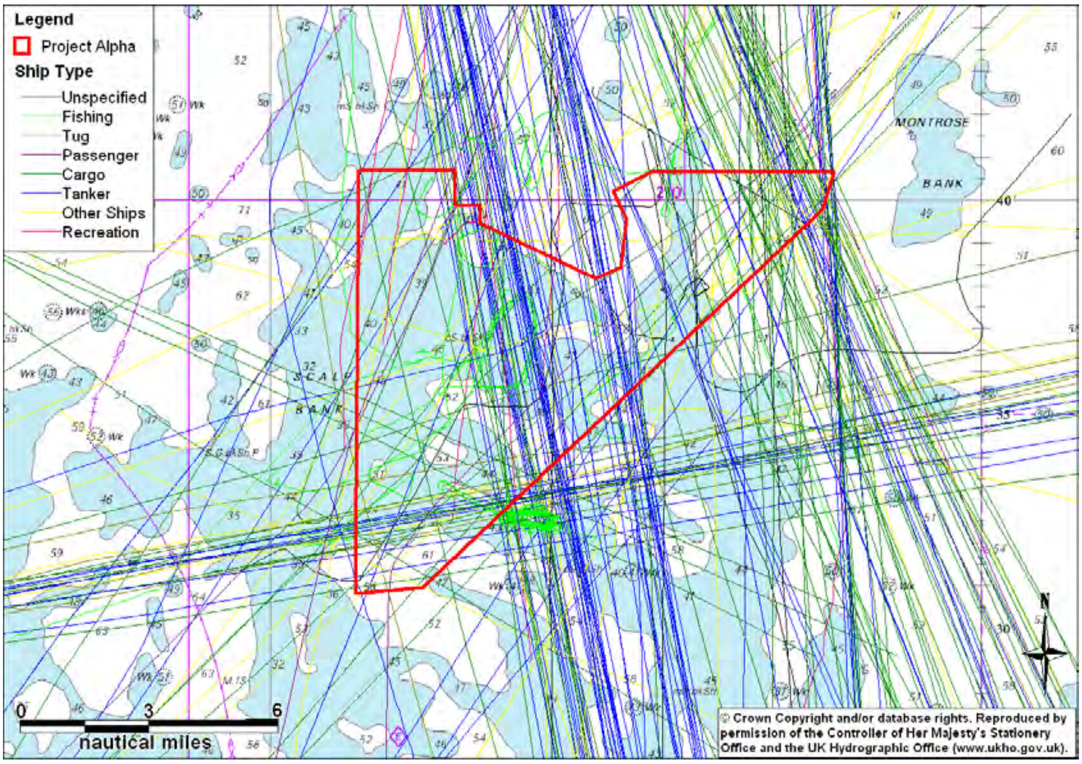

Figure 8.16 Combined Survey Tracks Passing through Project Alpha (40 days)

An average of four to five unique vessels were recorded intersecting Project Alpha during the 40-day survey period. Excluding unspecified vessels (these include radar targets which were not identified visually and vessels which did not specify a type on their AIS), the most common types of vessels passing through Project Alpha were tankers (39%) and cargo vessels (36%).

The most common destinations for vessels passing through Project Alpha were northern Scottish ports such as Aberdeen, Dundee and Peterhead, and eastern UK ports such as Immingham.

The large majority of non-AIS vessels intersecting the wind farm were fishing vessels (including small scallop dredgers) and a number of recreational vessels headed north/south during the summer survey.

8.4.2 Tankers

A plot of tankers recorded intersecting the Project Alpha site during the 40 day survey period is presented in Figure 8.17.

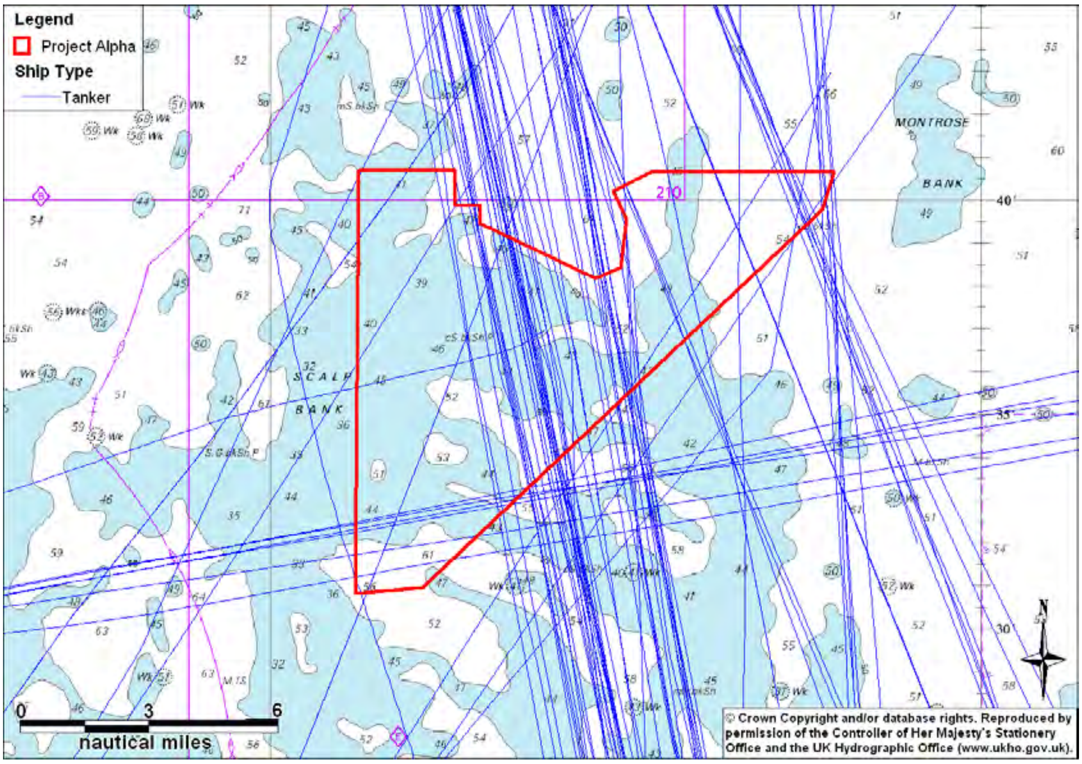

Figure 8.17 Tanker Tracks Passing through Project Alpha (40 days)

There were an average of two tankers per day intersecting the Project Alpha site during the 40 day survey period.

8.4.3 Cargo Vessels

A plot of cargo vessels recorded intersecting the Project Alpha site during the 40 day survey period is presented in Figure 8.18.

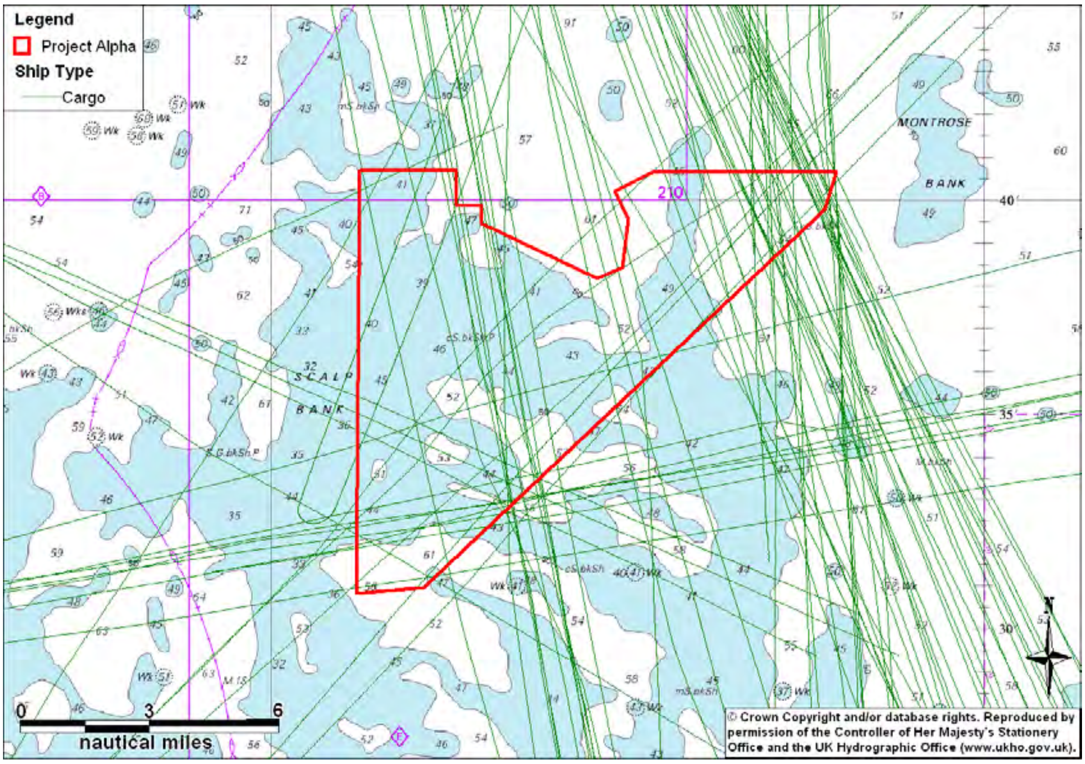

Figure 8.18 Cargo Tracks Passing through Project Alpha (40 days)

There were an average of two cargo vessels per day intersecting the Project Alpha site during the 40 day survey period.

8.4.4 Passenger/Cruise Vessels

A plot of passenger/cruise vessels intersecting the Project Alpha siteduring the 40 day survey period is presented in Figure 8.19.

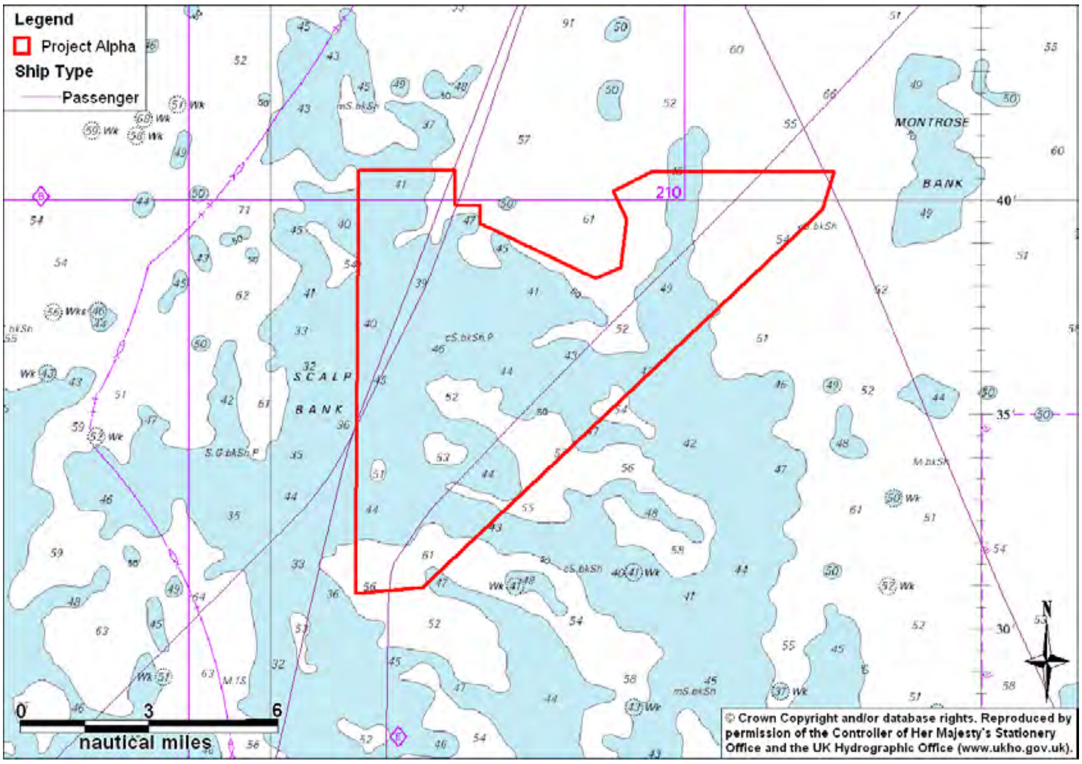

Figure 8.19 Passenger Tracks Passing through Project Alpha (40 days)

Four individual passenger/cruise vessels were recorded passing through the Project Alpha site headed to Scottish ports such as Rosyth, Aberdeen and Invergordon.

8.4.5 Other Vessels

A plot of 'other' vessels recorded intersecting the Project Alpha site during the 40 day survey period is presented in Figure 8.20.

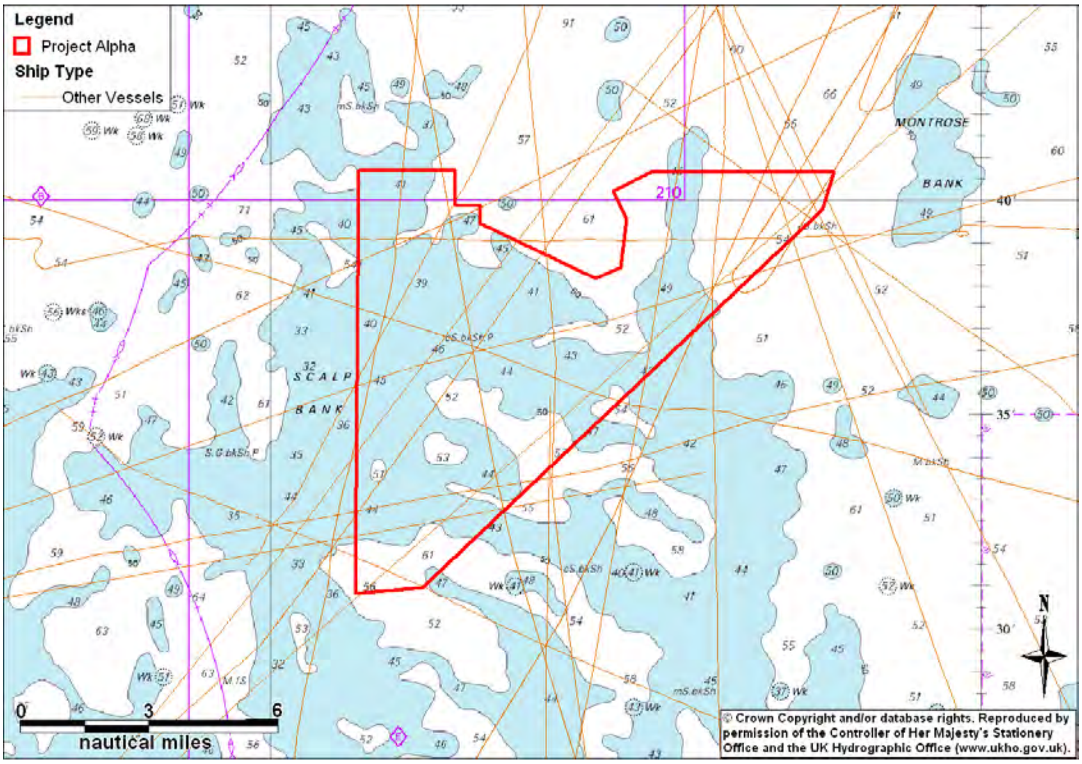

Figure 8.20 Other Vessel Tracks Passing through Project Alpha (40 days)

19 unique vessels with their type specified as 'other' passed through the Project Alpha site during the 40 day survey period. The majority of these vessels were offshore support/survey vessels or dive support vessels.

8.4.6 Fishing Vessels

A plot of fishing vessels recorded intersecting the Project Alpha site during the 40 day survey period is presented in Figure 8.21.

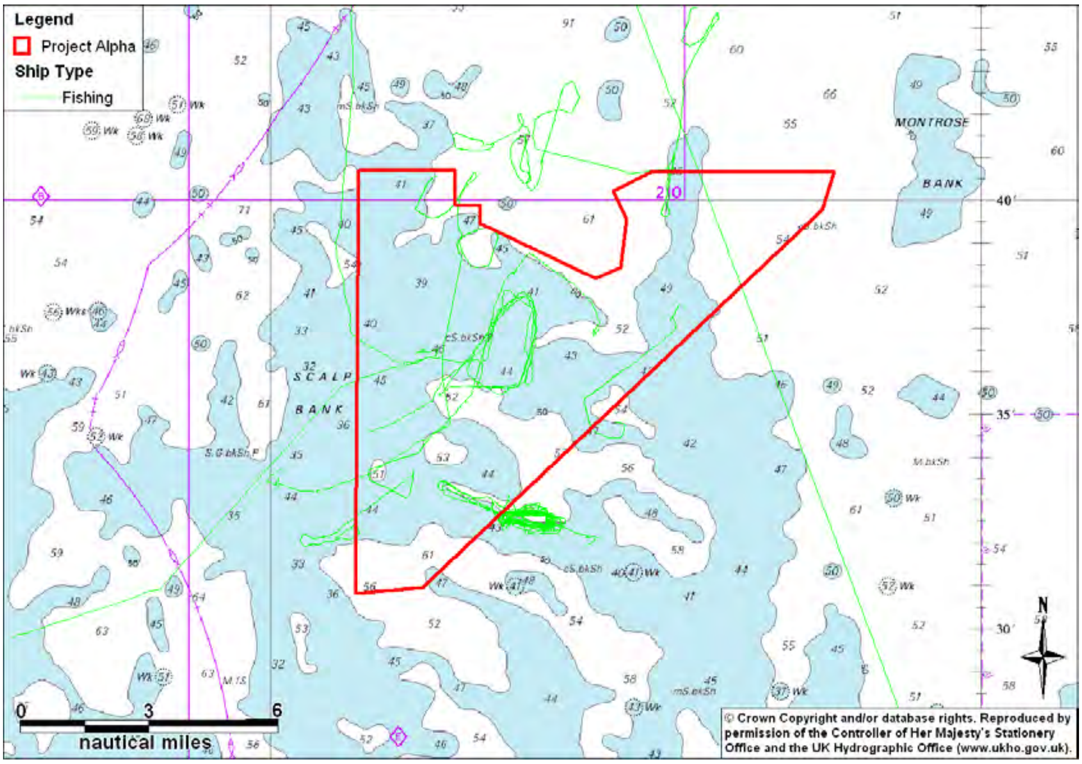

Figure 8.21 Fishing Tracks Passing through Project Alpha (40 days)

Four unique fishing vessels were recorded on radar and AIS during the survey within the Project Alpha site.

8.4.7 Recreation Vessels

A plot of recreation vessels recorded intersecting the Project Alpha site during the 26 day summer survey period is presented in Figure 8.22. No recreational vessels were recorded during the winter survey.

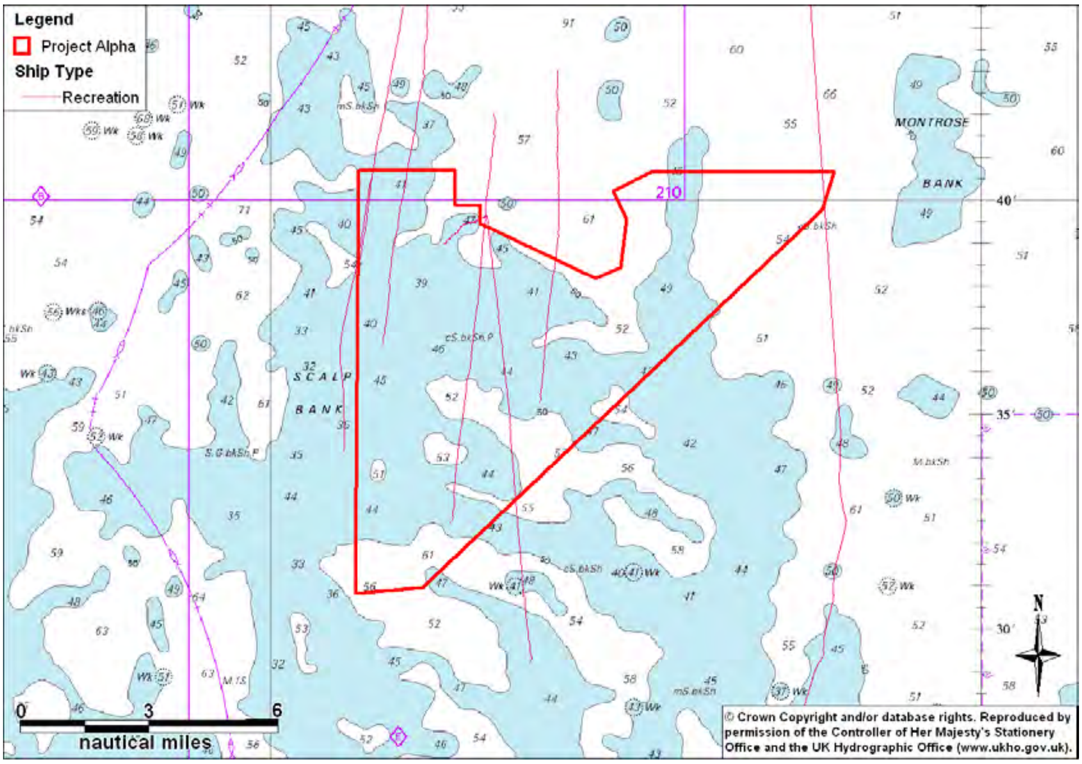

Figure 8.22 Recreation Tracks Passing through Project Alpha (40 days)

Of the six recreational vessel tracks which passed through the Project Alpha site, two were recorded on AIS and four on radar. Recreational vessel tracks were recorded passing through the Project Alpha site in a north to south direction and were likely to be headed to/from Northern Scottish marinas including Peterhead.

8.5 *Site-Specific Review for Project Bravo*

This section presents detailed plots of the vessel tracks which intersected the Project Bravo site during the 40 day *EEMS* and *Highland Eagle* survey.

Charts of the main vessel types passing through the Project Bravo site are presented in the following sub-sections. The analysis of data includes the following:

- Intersecting Vessels (all types) (Figure 8.23);
- Tankers (Figure 8.24);
- Cargo Vessels (Figure 8.25);
- Passenger Ships (Figure 8.26);

- Other Vessels (Figure 8.27);
- Fishing Vessels (Figure 8.28); and
- Recreational Vessels (Figure 8.29).

8.5.1 Intersecting Vessels (All Types)

Figure 8.23 presents the tracks of all vessels which were identified as passing through the Project Bravo site during the combined 40-day survey period.

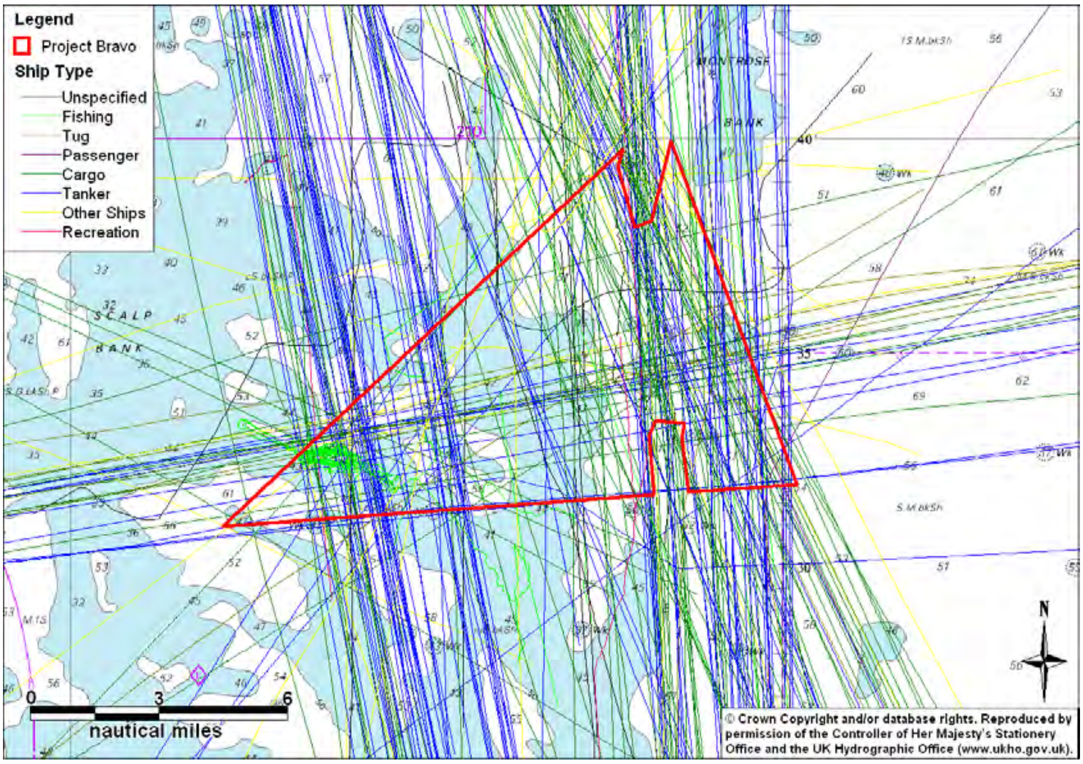

Figure 8.23 Combined Survey Tracks Passing through Project Bravo (40 days)

An average of five to six unique vessels were recorded intersecting the Project Bravo site during the 40-day survey period. Excluding unspecified vessels (these include radar targets which were not identified visually and vessels which did not specify a type on their AIS), the most common types of vessels passing through the Project Bravo site were tankers (46%) and cargo vessels (35%).

The most common destinations for vessels passing through the Project Bravo sitewere northern Scottish ports such as Aberdeen, Dundee, Inverness and Peterhead, and eastern UK ports such as Immingham.

The large majority of non-AIS vessels intersecting the wind farm were fishing vessels (including small scallop dredgers) and a number of recreational vessels headed north/south during the summer survey.

8.5.2 Tankers

A plot of tankers recorded intersecting the Project Bravo site during the 40 day survey period is presented in Figure 8.24.

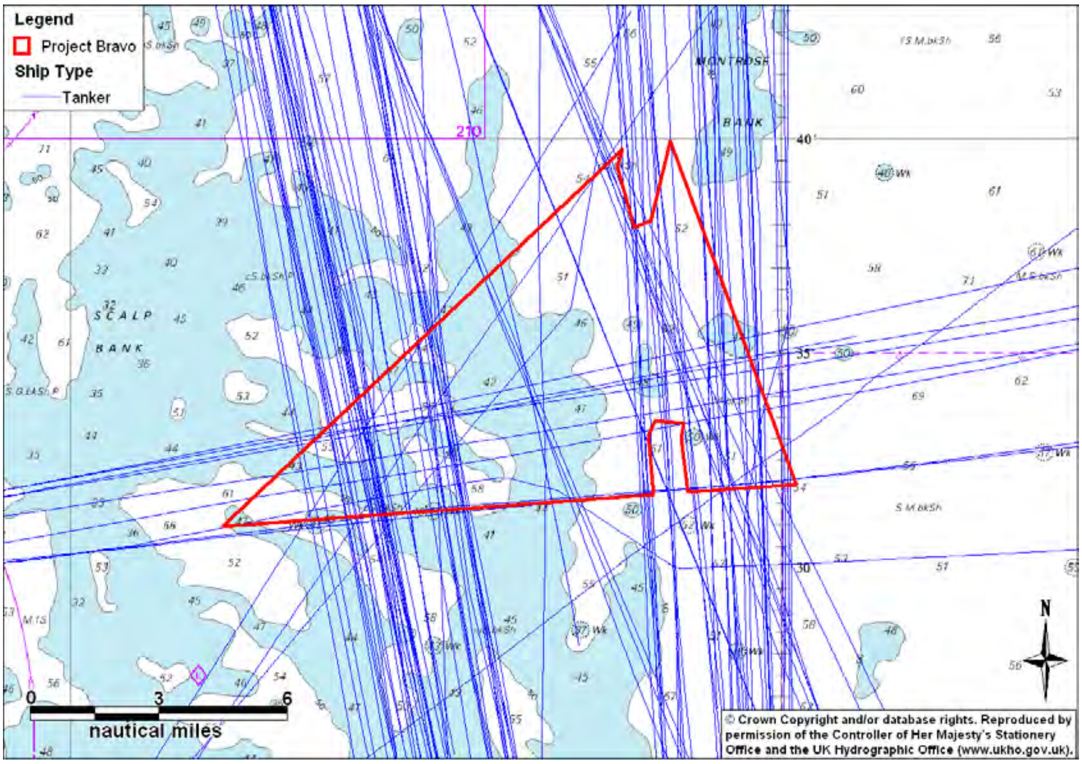

Figure 8.24 Tanker Tracks Passing through Project Bravo (40 days)

There were an average of three tankers per day intersecting the Project Bravo site during the 40 day survey period.

8.5.3 Cargo Vessels

A plot of cargo vessels recorded intersecting the Project Bravo site during the 40 day survey period is presented in Figure 8.25.

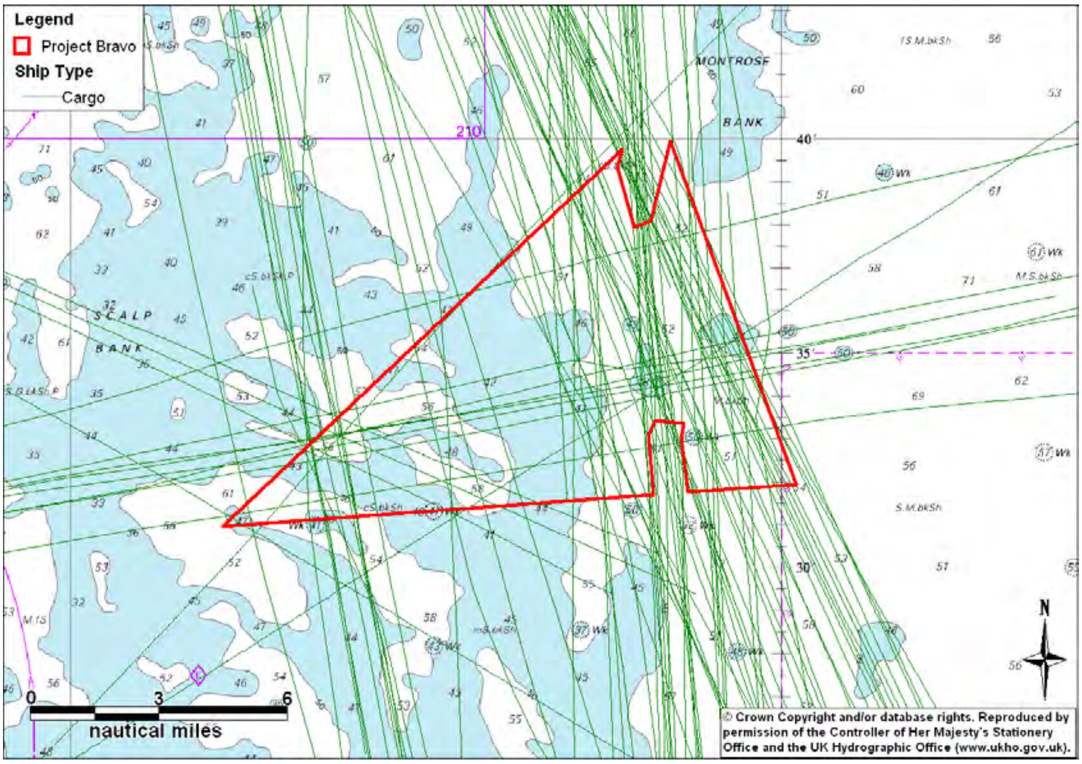

Figure 8.25 Cargo Tracks Passing through Project Bravo (40 days)

There were an average of two cargo vessels per day intersecting the Project Bravo site during the 40 day survey period.

8.5.4 Passenger/Cruise Vessels

A plot of passenger/cruise vessels intersecting the Project Bravo site during the 40 day survey period is presented in Figure 8.26.

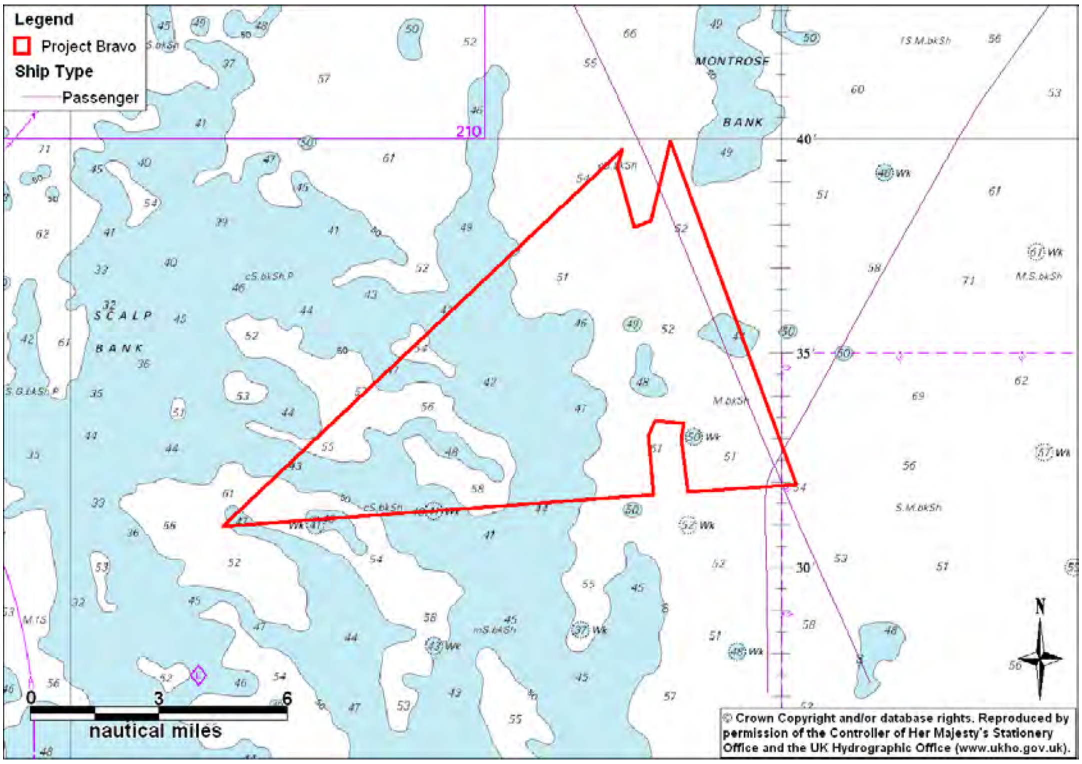

Figure 8.26 Passenger Tracks Passing through Project Bravo (40 days)

Two individual passenger/cruise vessels were recorded passing through the Project Bravo site headed to Scottish ports such as Rosyth and Aberdeen.

8.5.5 Other Vessels

A plot of 'other' vessels recorded intersecting the Project Bravo site during the 40 day survey period is presented in Figure 8.27.

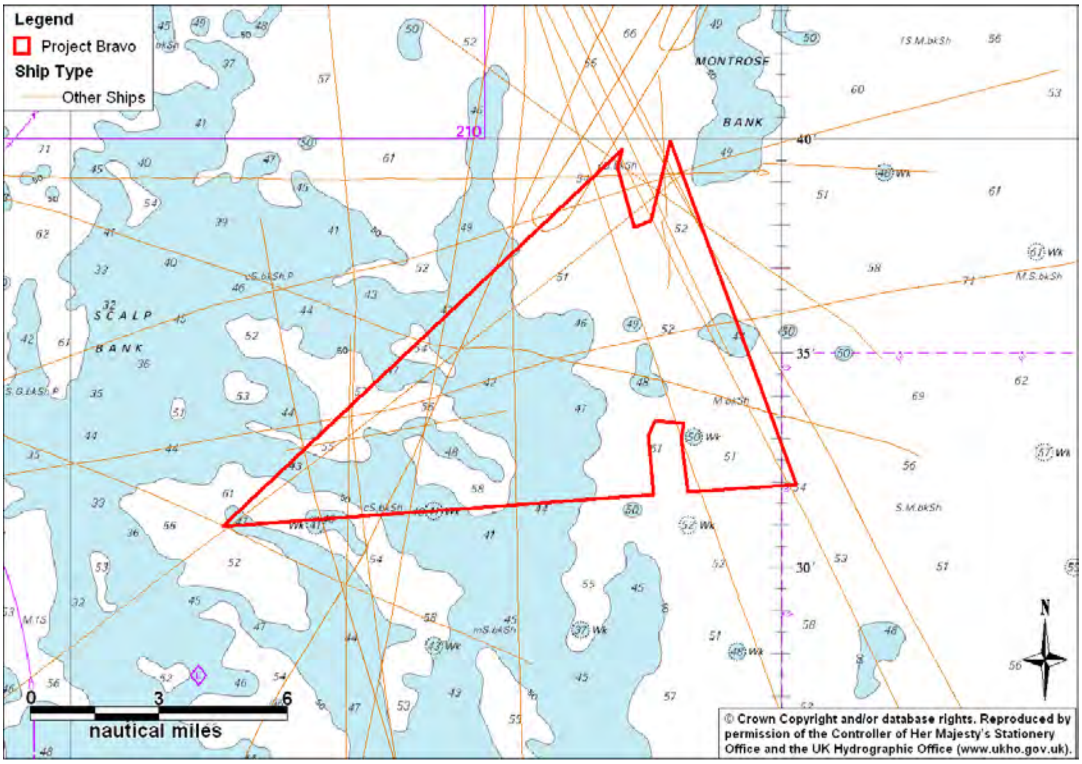

Figure 8.27 Other Vessel Tracks Passing through Project Bravo (40 days)

17 unique vessels with their type specified as 'other' passed through the Project Bravo site during the 40 day survey period. The majority of these vessels were offshore support/survey vessels or dive support vessels.

8.5.6 Fishing Vessels

A plot of fishing vessels recorded intersecting the Project Bravo site during the 40 day survey period is presented in Figure 8.28.

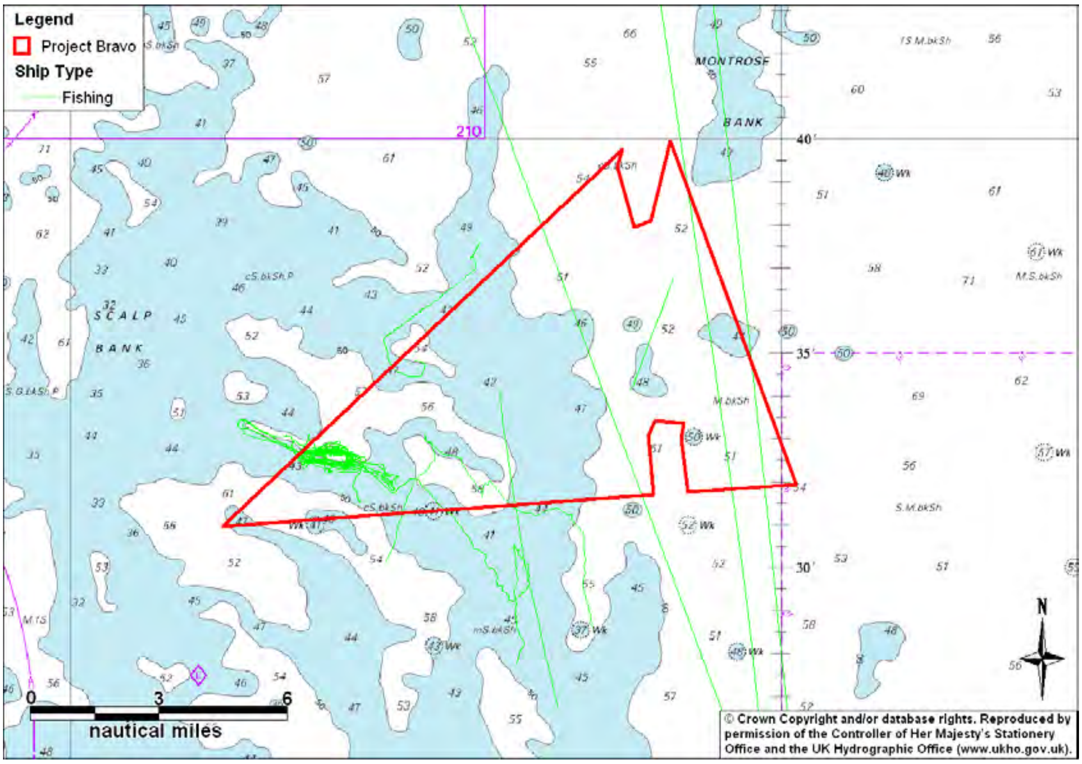

Figure 8.28 Fishing Tracks Passing through Project Bravo (40 days)

Four unique fishing vessels were recorded on radar and AIS during the survey within the Project Bravo site.

8.5.7 Recreation Vessels

A plot of recreation vessels recorded intersecting the Project Bravo site during the 26 day summer survey period is presented in Figure 8.29. No recreational vessels were recorded during the winter survey.

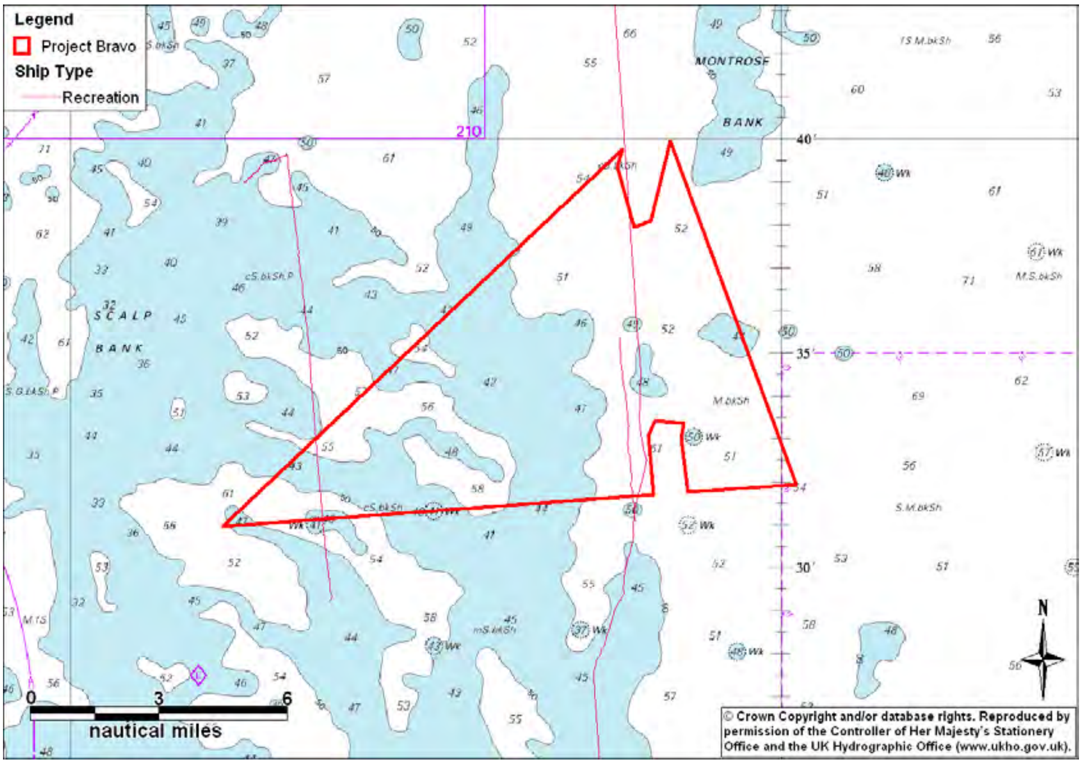

Figure 8.29 Recreation Tracks Passing throughProject Bravo (40 days)

Of the three recreational vessel tracks which passed through the Project Bravo site, one was recorded on AIS and two on radar. Recreational vessel tracks were recorded passing through the Project Bravo site in a north to south direction and were likely to be headed to/from Northern Scottish marinas including Peterhead and Inverness.

8.6 *Anchored Vessels*

Anchored vessels were identified based on AIS navigational status which is set on the AIS unit onboard a vessel. Information is manually inputted into the AIS transponder (voyage related information); therefore it is occasionally observed that ships do not update the navigational status if they are anchored for only a short period of time. Subsequently, the data was analysed for vessels with low speeds or ship tracks which showed signs of anchoring.

The vessels that broadcast their navigation status as ‘at anchor’ during the combined surveys were to the west of the Phase 1 wind farms off Montrose. Figure 8.30 shows the two vessels anchored relative to the Project Alpha and Project Bravo sites within Phase 1. It is noted that no vessels were identified as been at anchor within 10nm of Phase 1 during the summer survey.

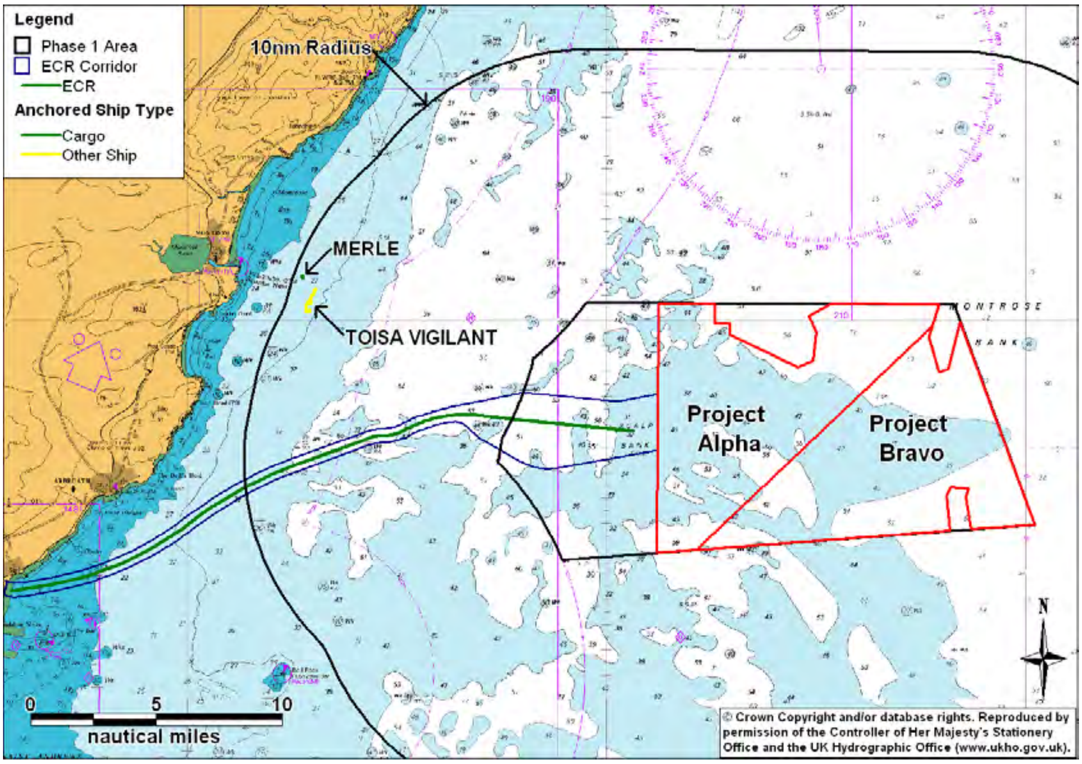

Figure 8.30 Anchored Vessels Recorded within 10nm of Phase 1 Wind Farms

The offshore supply vessel *Toisa Vigilant* was the closest anchored vessel relative to the Phase 1 wind farms, approximately 13.5nm to the west of Project Alpha. This vessel was anchored on 22 March 2011 before heading into the port of Montrose on the 23 March 2011.

The other anchored vessel was the general cargo vessel *Merle* located 14nm west of Project Alpha. This vessel was anchored on the 17 and 18 March 2011 before heading into the port of Montrose.

8.7 *Detailed Analysis of Main Shipping Lanes*

8.7.1 Main Shipping Lanes

Plots of the main 90th percentiles relative to Phase 1 and the proposed wind farms are presented in Figure 8.31.

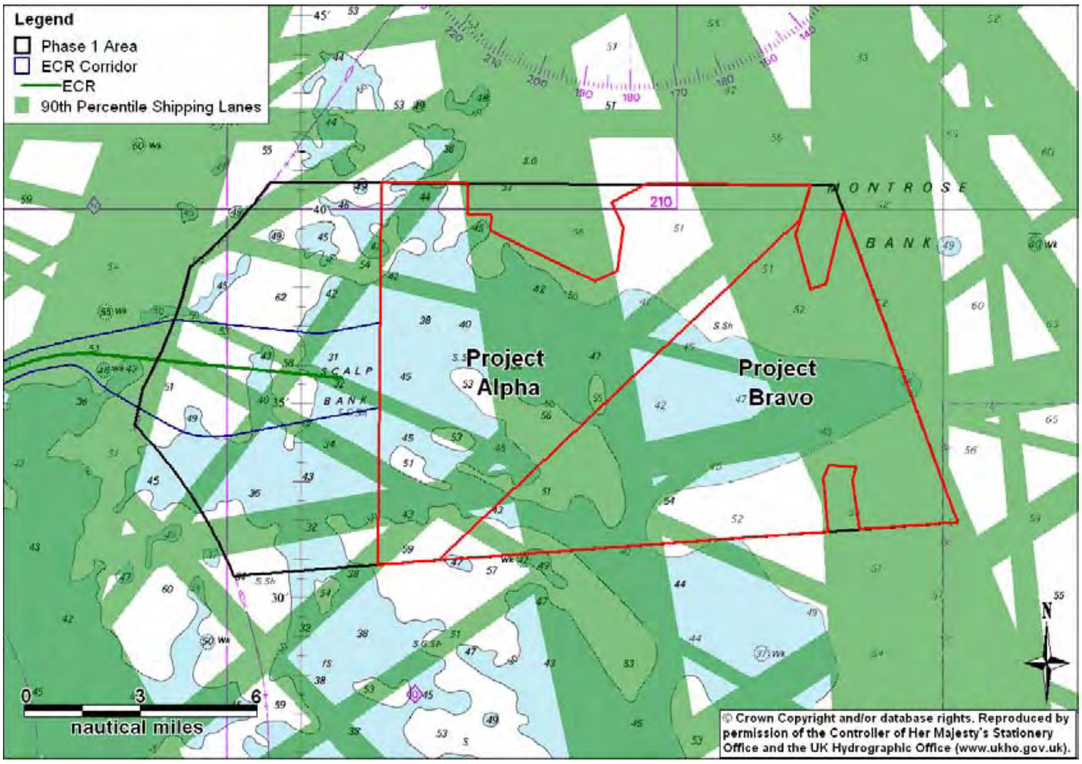

Figure 8.31 90th Percentile Lanes

Eight main commercial vessels routes have been identified as transiting through the Phase 1 wind farm sites. Figure 8.32 presents the mean intersecting shipping routes.

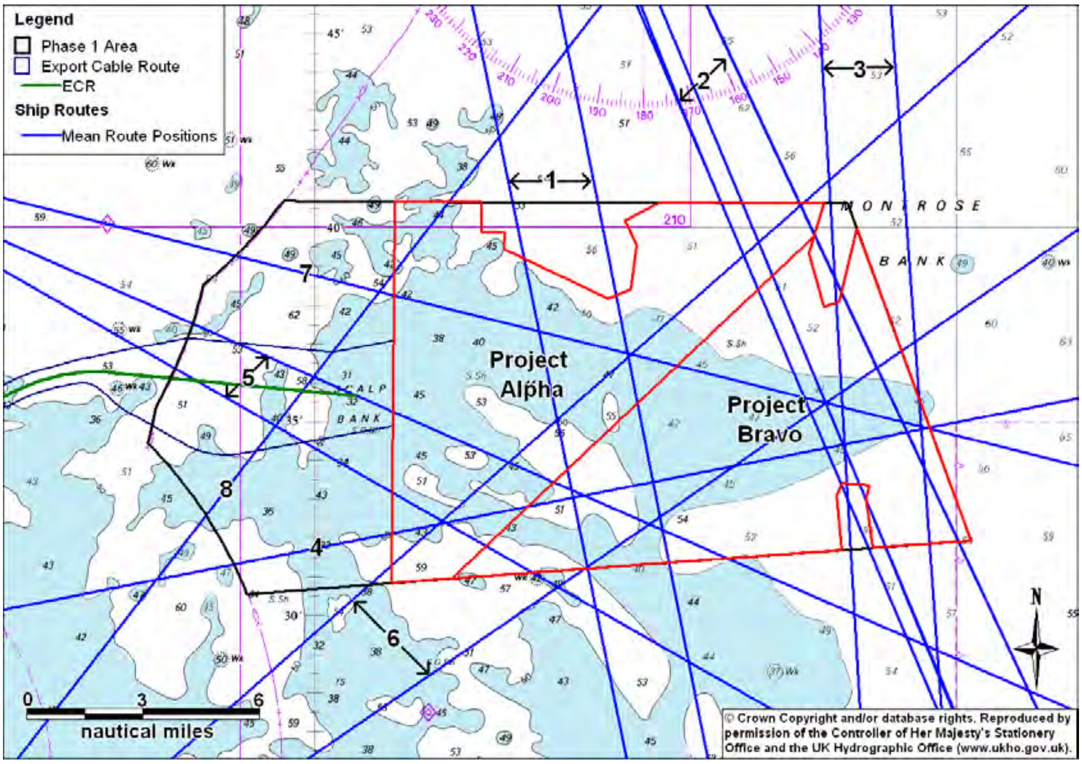

Figure 8.32 Main Routes Intersecting Project Alpha and Project Bravo

A brief description of the traffic on each of the routes intersecting the proposed wind farm sites is presented in Table 8.1.

Table 8.1 Intersecting Routes Description

Route Number	Average Vessels per Day	Description
Route 1	1.6	A wide route mainly used by tankers (70%) headed between Aberdeen and the Humber (Immingham).
Route 2	1.3	A wide route mainly used by larger vessels than on Route 1 (cargo vessels (57%) and tankers (24%)), headed between Aberdeen, Belgium, The Netherlands and the Humber (Immingham).
Route 3	1.3	A wide route mainly used by tankers (59%) and cargo vessels (31%) headed between Northern Scottish ports including Inverness, Lerwick, Invergordon, Buckie and Peterhead to the Humber (Immingham).
Route 4	0.5	Route 4 is used by cargo vessels (39%), tankers (33%) and offshore vessels (28%). Vessels are headed between offshore platforms (e.g. Elgin Field), Scandinavian ports (Gdansk, Copenhagen and Gothenburg) and Dundee and Perth.

Route Number	Average Vessels per Day	Description
Route 5	0.1	Low use route used by cargo vessels between Montrose and Germany/Denmark.
Route 6	0.2	Low use route used by cargo vessels and offshore vessels. A small number of cruise/passenger vessels also use this route. Vessels are headed inbound to Leith and Rosyth, with a number of outbound vessels headed to the North Sea and Norwegian ports of Bergen and Stavanger.
Route 7	0.03	Very low use route used by cargo vessels between Montrose and Denmark.
Route 8	0.08	Very low use route used by large tankers and cargo vessels headed to Grangemouth, Hound Point and Leith.

9. EFFECTS ON COMMERCIAL SHIPPING NAVIGATION – PROJECT ALPHA

9.1 *Introduction*

This section considers the effects on commercial shipping navigation from Project Alpha based on the maritime traffic surveys (Section 8). It has been identified that seven of the routes described in Section 8.7 could potentially be affected by the proposed wind farm.

Note that routes with less than one vessel per day are not being further analysed in this section. All routes are modelled within the collision risk modelling.

The two routes which have more than one vessel per day and pass through Project Alpha are described in more detail below and alternative routes presented.

9.2 *Passing Ships*

9.2.1 Route 1: Aberdeen to Humber

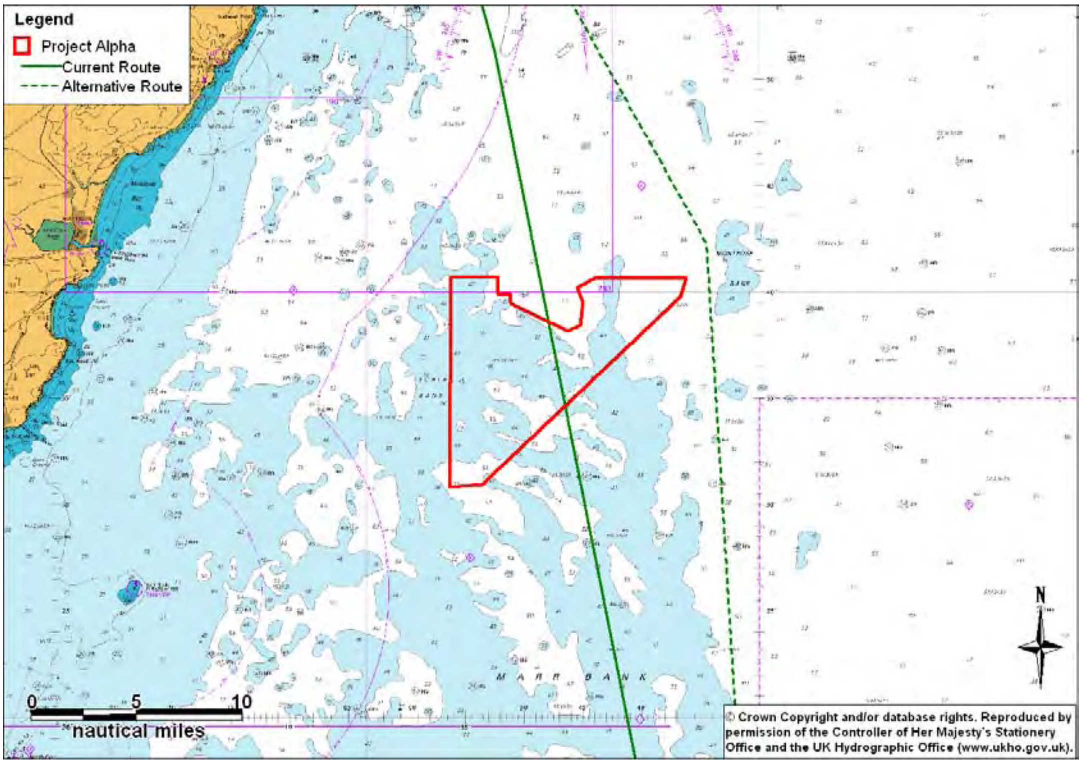

Figure 9.1 Route 1 Current and Alternative

On average 1.6 vessels per day transit on Route 1 between Aberdeen and Humber. The vast majority of traffic on this route is tankers (70%) with a small number of cargo vessels also being recorded. It is expected that vessels on this route will route to the east following the construction of Project Alpha to achieve a minimum passing distance of 1.0nm from the wind farm site boundary. This would result in increasing the voyage distance by approximately 1.3nm. It is noted there is sufficient sea room for vessels to pass further from the site, should they consider it necessary, for example, in adverse weather conditions.

9.2.2 Route 2: Aberdeen to Humber and European Ports

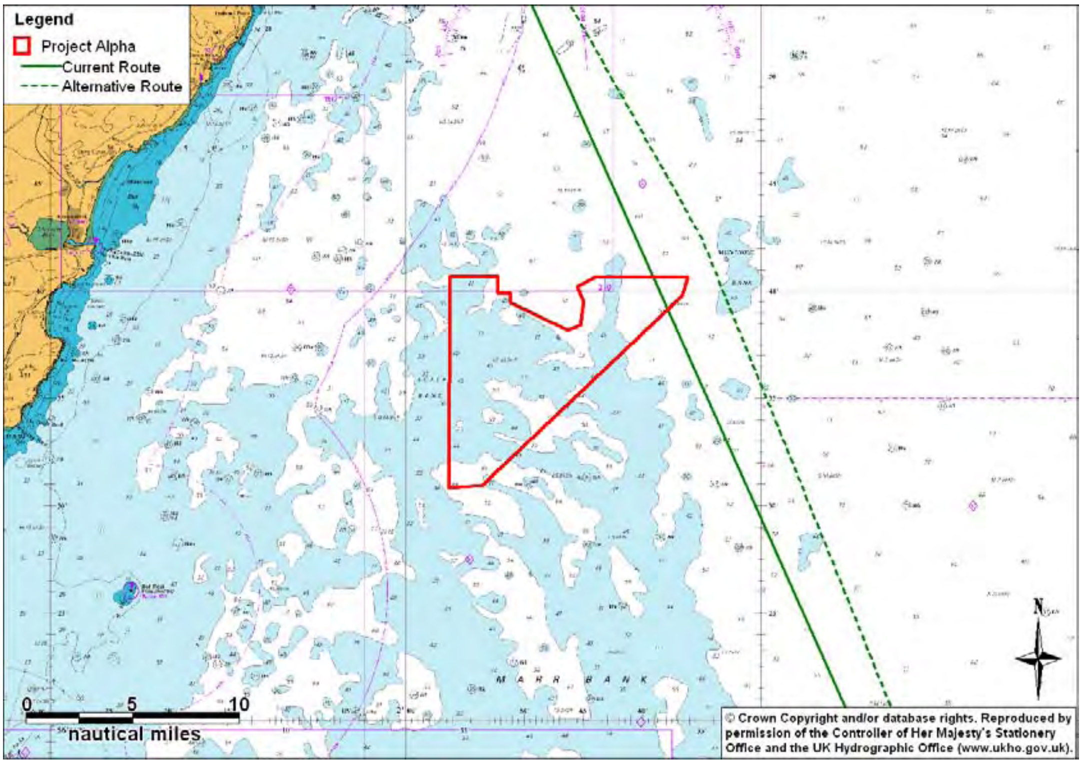

Figure 9.2 Route 2 Current and Alternative

Route 2 is used by an estimated 1.3 vessels per day transiting between Aberdeen and Eastern UK ports such as Humber/European ports in Belgium and The Netherlands. Traffic on this route mainly comprises cargo vessels (57%) and tankers (24%). Due to the presence of Project Alpha, it is expected that vessels on this route will make a slight course alteration to the east in order to achieve a distance of at least 1nm from the wind farm site boundary. It is not anticipated that this route deviation would notably affect the overall voyage distance. As was the case with Route 1, there is sufficient sea room for vessels to pass further from the site, should they consider it necessary, for example, in adverse weather conditions.

10. EFFECTS ON COMMERCIAL SHIPPING NAVIGATION – PROJECT BRAVO

10.1 *Introduction*

This section considers the effects on commercial shipping navigation from Project Bravo based on the maritime traffic surveys (Section 8). It has been identified that seven of the routes described in Section 8.7 could potentially be affected by the Project Bravo proposal.

Note that routes with less than one vessel per day are not being further analysed in this section. All routes are modelled within the collision risk modelling.

The three routes which have more than one vessel per day and pass through Project Bravo are described in more detail below and alternative routes presented.

10.2 *Passing Ships*

10.2.1 Route 1: Aberdeen to Humber

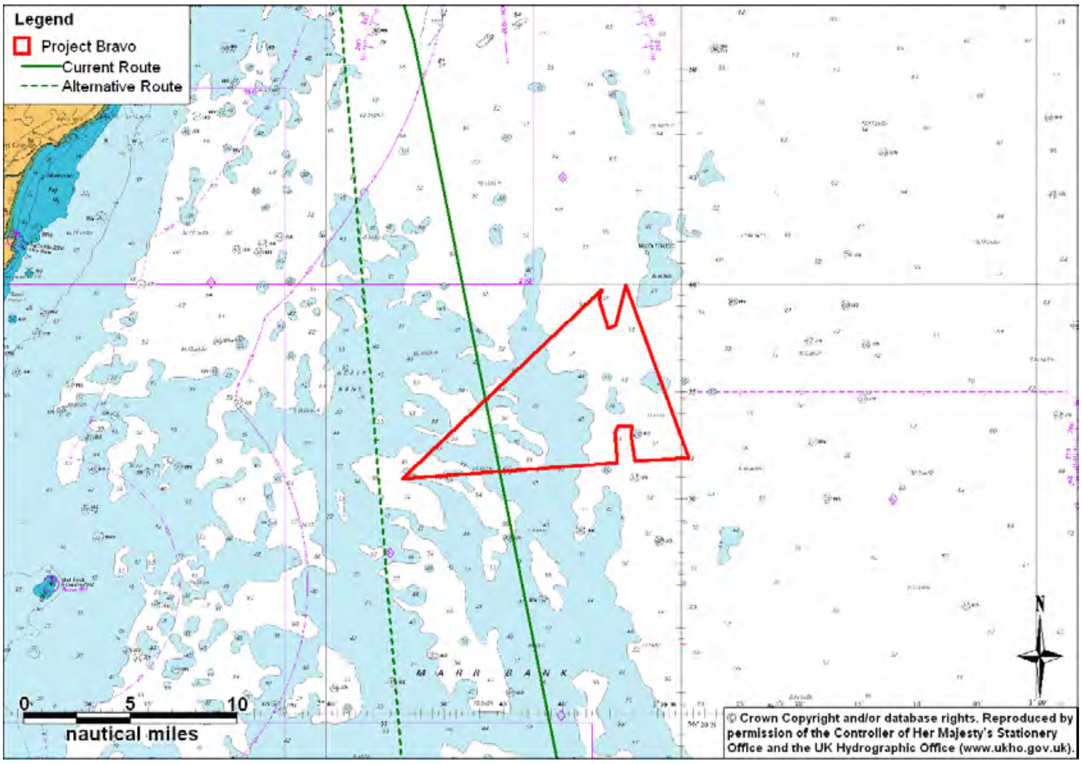

Figure 10.1 Route 1 Current and Alternative

On average 1.6 vessels per day transit on Route 1 between Aberdeen and Humber. The vast majority of traffic on this route is tankers (70%) with a small number of cargo vessels also being recorded. It is expected that vessels on this route will route to the west following the construction of Project Bravo to achieve a minimum passing distance of 1.0nm from the wind farm site boundary. This would result in increasing the voyage distance by approximately 2.4nm. It is noted there is sufficient sea room for vessels to pass further from the site, should they consider it necessary, for example, in adverse weather conditions.

10.2.2 Route 2: Aberdeen to Humber and European Ports

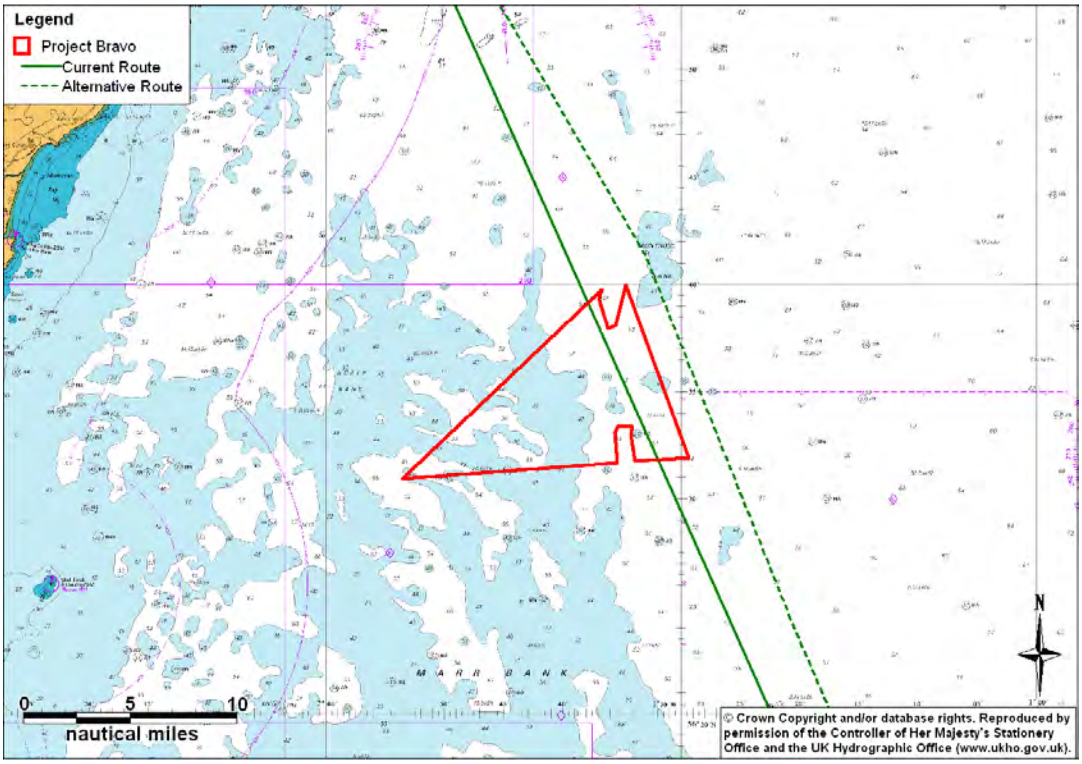

Figure 10.2 Route 2 Current and Alternative

Route 2 is used by an estimated 1.3 vessels per day transiting between Aberdeen and Eastern UK ports such as Humber/European ports in Belgium and The Netherlands. Traffic on this route mainly comprises cargo vessels (57%) and tankers (24%). Due to the presence of Project Bravo, it is expected that vessels on this route will make a slight course alteration to the east in order to achieve a distance of at least 1nm from the wind farm site boundary. It is not anticipated that this route deviation would notably affect the overall voyage distance. There is sufficient sea room to the east of the site for vessels to pass further from the site, should they consider it necessary, for example, in adverse weather conditions.

10.2.3 Route 3: Northern Scottish Ports and Humber

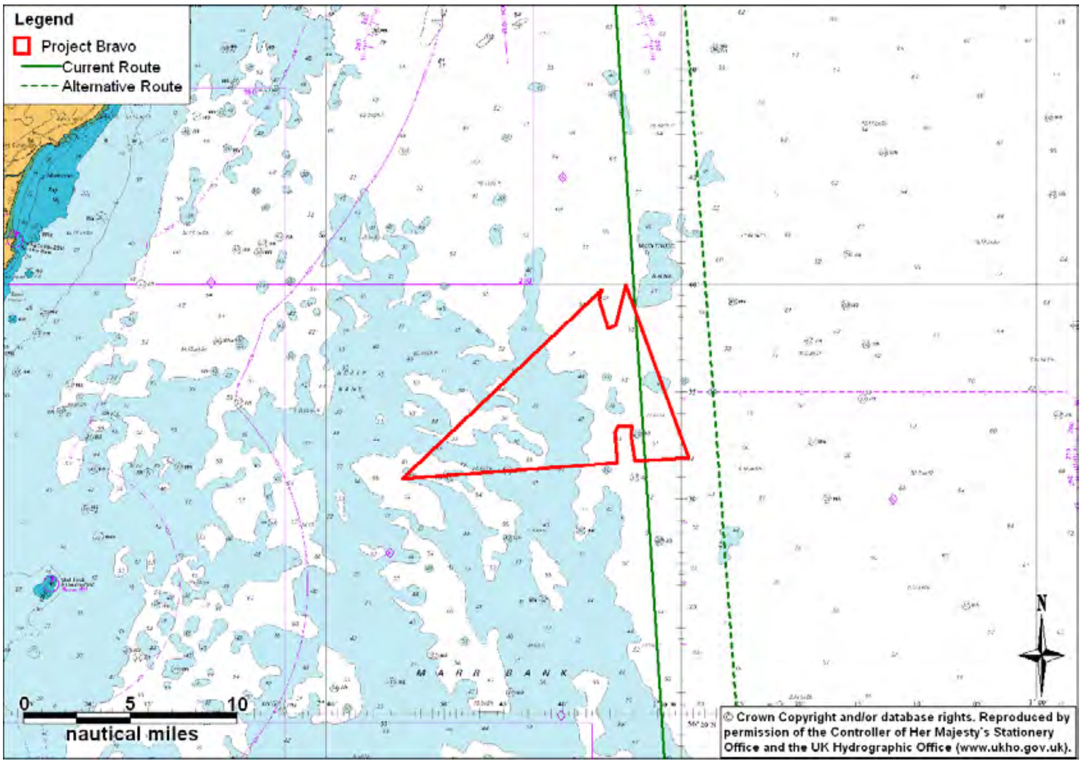

Figure 10.3 Route 3 Current and Alternative

It has been estimated that an average of 1.3 vessels per day use Route 3 between Northern Scottish ports and Humber with the majority of vessels comprising tankers (59%) and cargo vessels (31%). In order to achieve a safe passing distance of 1nm, it is expected that vessels on this route will make a slight course alteration to the east following the construction of Project Bravo. It is not anticipated that this route deviation would notably affect the overall voyage distance. There is sufficient sea room to the east of the site for vessels to pass further from the site, should they consider it necessary, for example, in adverse weather conditions.

11. EFFECT ON RECREATIONAL VESSEL ACTIVITY

11.1 *Introduction*

This section reviews recreational vessel activity within 10nm of the Project Alpha and Project Bravo sites based on information published by the RYA and vessels tracked during the maritime traffic survey undertaken by the *Highland Eagle* in June/July 2011. Note that no recreation vessel tracks were picked up during the *EEMS* winter survey.

A review of recreational activity in proximity to the ECR and a description of the effect on recreation vessels is presented in Appendix A.

11.2 *RYA Data*

11.2.1 Introduction

The RYA, supported by the Cruising Association (CA), have identified recreational cruising routes, general sailing and racing areas around the UK in the Coastal Atlas (Ref. xii). This work was based on extensive consultation and qualitative data collection from RYA and CA members, through the organisations' specialist and regional committees and through the RYA affiliated clubs. The consultation was also sent to berth holder associations and marinas.

The reports note that recreational boating, both under sail and power is highly seasonal and highly diurnal. The division of recreational craft routes into Heavy, Medium and Light Use is therefore based on the following classification:

- *Heavy Recreational Routes*: - Very popular routes on which a minimum of six or more recreational vessels will probably be seen at all times during summer daylight hours. These also include the entrances to harbours, anchorages and places of refuge;
- *Medium Recreational Routes*: - Popular routes on which some recreational craft will be seen at most times during summer daylight hours; and
- *Light Recreational Routes*: - Routes known to be in common use but which do not qualify for medium or heavy classification.

11.2.2 Phase 1 Recreational Data

An overview and detailed plot of the recreational sailing activity and facilities in the east of Scotland and in the vicinity of the Phase 1 wind farms are presented in Figure 11.1 and Figure 11.2 respectively.

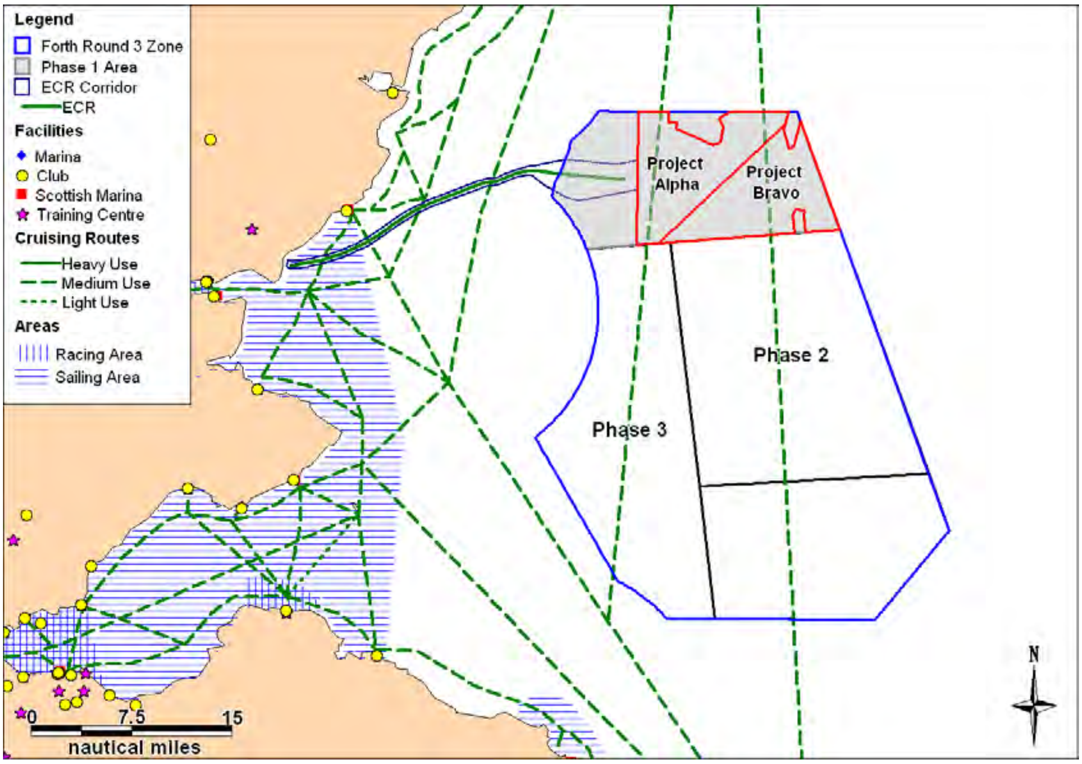

Figure 11.1 Overview of Recreational Information for the East of Scotland

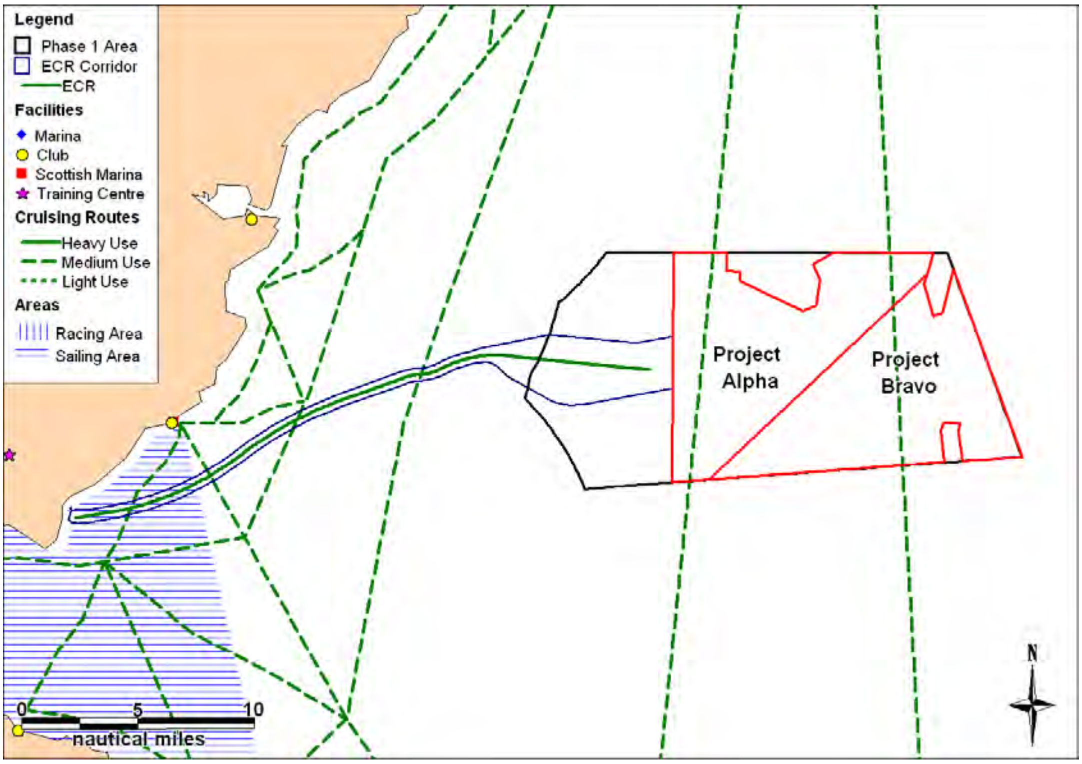

Figure 11.2 Detailed Recreational Information for Project Alpha and Project Bravo

Based on the RYA published data, it can be seen that the proposed wind farm sites are intersected by two 'medium use' cruising routes, both of which run in a north-south direction. All other routes pass at least 9nm from the Phase 1 wind farms.

In terms of facilities, the nearest marina is located at Arbroath approximately 21nm west of the Project Alpha site. The nearest clubs are the Montrose Sailing Club (approximately 18nm north west of the proposed wind farm sites) and the Arbroath Sailing and Boating Club (approximately 21nm west of the proposed wind farm sites).

11.3 *Survey Data (Project Alpha)*

No recreational vessels were recorded during the winter *EEMS* survey (March 2011); therefore all the recreational tracks presented in Figure 11.3 were recorded during the *Highland Eagle* survey (June/July 2011). The effective survey period was 26 days (AIS and radar).

Seven recreational vessel tracks intersected the Project Alpha site. Overall, 21 recreational vessel tracks were recorded within 10nm of the Project Alpha site during the 26 day survey period, meaning that the frequency of recreational vessels within 10nm of the Project Alpha site is less than one vessel per day. It should be noted however that the same vessel may have been recorded more than once so the number of unique vessels may actually be less than 21. During the survey, 29% of vessels were tracked with AIS whilst 71% were recorded on radar. A plot of the recreational tracks within 10nm of Project Alpha is presented in Figure 11.3.

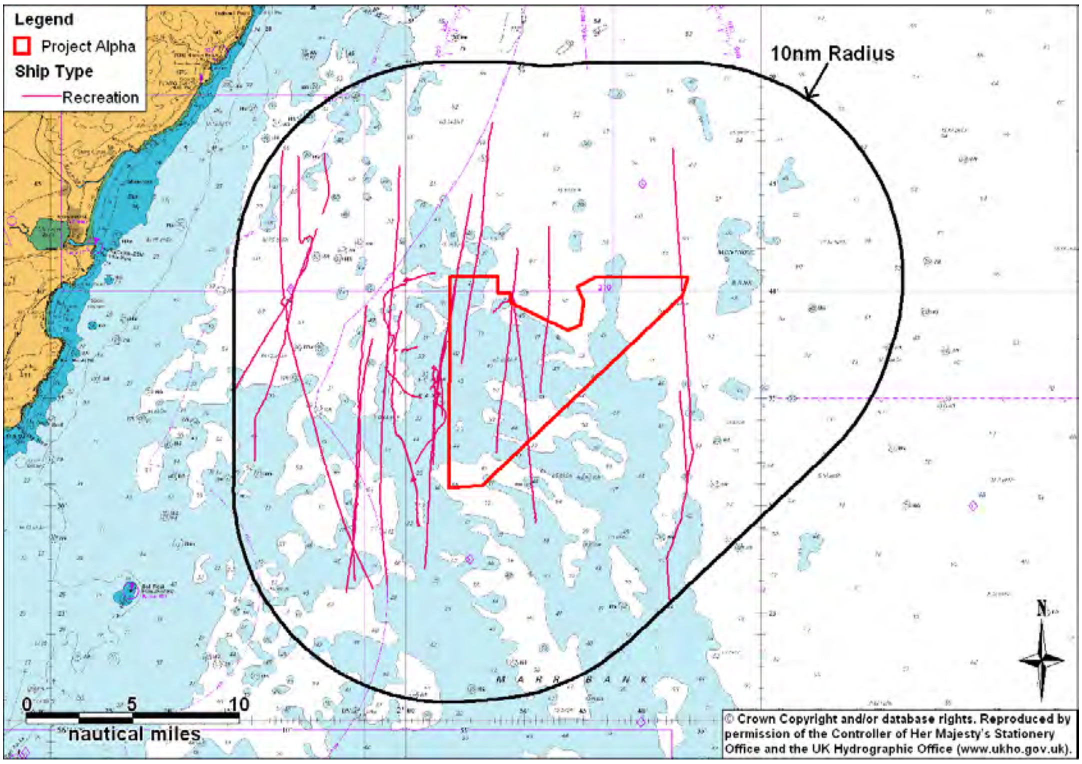

Figure 11.3 Recreation Vessel Tracks June/July 2011 within 10nm of Project Alpha (26 days)

Recreational vessels were mainly headed in a north-south direction, as was seen in the RYA Cruising Routes (see Figure 11.2). They were most frequently recorded to the west of Project Alpha.

11.4 *Impact Assessment (Project Alpha)*

The air clearance between WTG rotors and sea level conditions at Mean High Water Springs (MHWS) will not be less than 22m, as guided by the MCA MGN 371. This minimises the risk of interaction between rotor blades and yacht masts. The RYA previously also recommended a minimum air clearance of 22m at MHWS, but this recommendation has been altered to be 22m at HAT. Adoption of this change is currently being discussed at the NOREL group.

In terms of vessel routeing, recreational vessels should be able to pass between wind farm structures in suitable conditions. Recreational vessels routeing through the site are likely to be clear of larger vessels navigating around the wind farm, which is likely to result in a reduction in encounters. However, additional risks are created given the fact that recreational vessels may exit the wind farm into routes used by commercial/fishing vessels and that there could be a reduction in radar tracking performance for vessels in close proximity to the wind farm. Recreational vessels will also be impacted by the presence of construction/cable laying vessels which increase the likelihood of encounters and hence the collision risk. The ECR has the potential to impact recreational vessels required to anchor, but this is unlikely along much of the ECR Corridor due to the water depth.

Based on the low level of recreational vessel activity within 10nm of Project Alpha, this is not expected to be a frequent event and hence the effect on recreational vessels is considered to be minor. This is in line with the feedback received during the recreational stakeholder consultation. The risks to recreational vessels are analysed further in Section 14.3.4.

11.5 *Survey Data (Project Bravo)*

No recreational vessels were recorded during the winter *EEMS* survey (March 2011); therefore all the recreational tracks presented in Figure 11.4 were recorded during the *Highland Eagle* survey (June/July 2011). The effective survey period was 26 days (AIS and radar).

Three recreational vessel tracks intersected the Project Bravo site. Overall, 18 recreational vessel tracks were recorded within 10nm of Project Bravo during the 26 day survey period, meaning that the frequency of recreational vessels within 10nm of Project Bravo is less than one vessel per day. It should be noted however that the same vessel may have been recorded more than once so the number of unique vessels may actually be less than 18. During the survey, 17% of vessels were tracked with AIS whilst 83% were recorded on radar. A plot of the recreational tracks within 10nm of the Project Bravo site is presented in Figure 11.4.

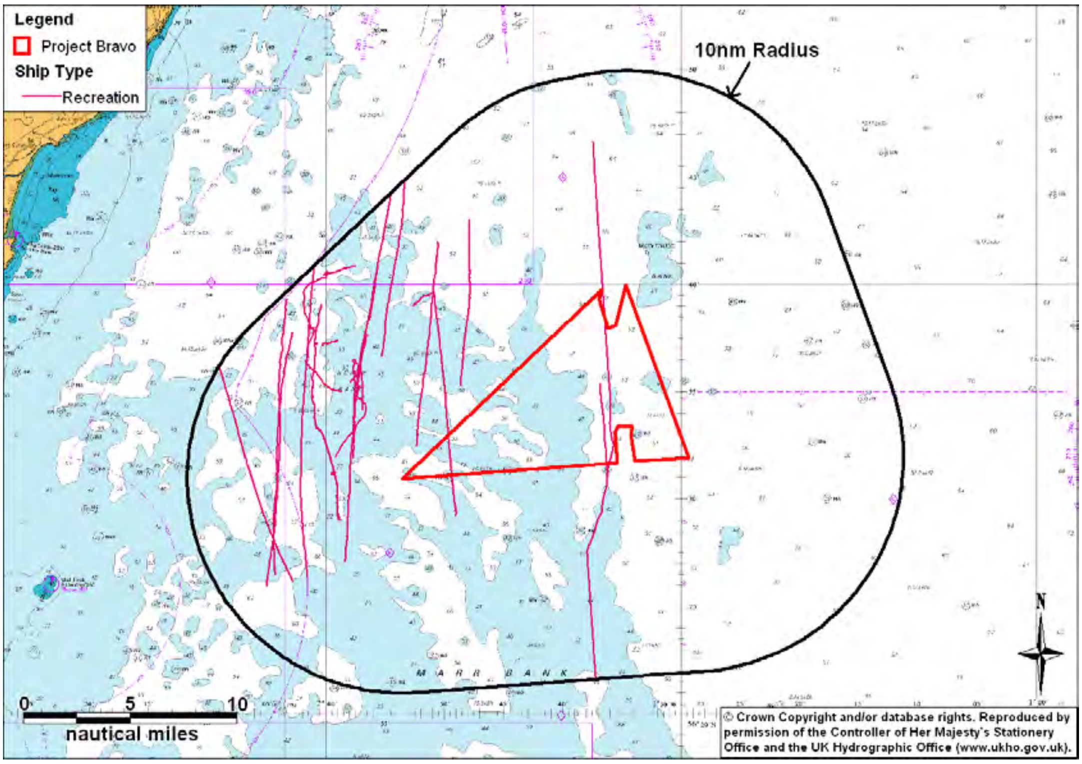

Figure 11.4 Recreation Vessel Tracks June/July 2011 within 10nm of Project Bravo (26 days)

Recreational vessels were mainly headed in a north-south direction, as was seen in the RYA Cruising Routes (see Figure 11.2). They were most frequently recorded to the west of Project Bravo.

An example of a recreational vessel observed within Project Bravo during the *Highland Eagle* survey is presented in Figure 11.5.

Figure 11.5 Recreational Vessel *Pink Cloud*

11.6 *Impact Assessment (Project Bravo)*

Based on the low level of recreational vessel activity within 10nm of Project Bravo, this is not expected to be a frequent event and hence the effect on recreational vessels is considered to be minor. This is in line with the feedback received during the recreational stakeholder consultation. The risks to recreational vessels are analysed further in Section 14.3.4.

12. EFFECTS ON FISHING VESSEL ACTIVITY

12.1 *Introduction and Data Overview*

This section reviews the fishing vessel activity within 10nm of the Project Alpha and Project Bravo sites based on data collected during the maritime traffic surveys and on sightings and satellite data.

A review of fishing activity in proximity to the ECR and a description of the effect on fishing vessels is presented in Appendix A.

12.1.1 Sightings Data Overview

Data on fishing vessel sightings were obtained from the Marine Management Organisation (MMO, formerly the Marine and Fisheries Agency. The Sea Fisheries Inspectorate (SFI) monitor the fishing industry's compliance with UK, European Union (EU) and international fisheries laws through the deployment of patrol vessels, surveillance aircraft and the SFI.

Each patrol logs the positions and details of all fishing vessels (UK and non-UK) within the area being patrolled. All vessels are logged, irrespective of size, provided they can be identified by their Port Letter Number (PLN).

Data was obtained for the five-year period (2005 to 2009). Sections 12.3 and 12.7 present the sightings data analysis for the Project Alpha and Project Bravo sites respectively.

12.1.2 Satellite Data Overview

The MMO operates a satellite vessel monitoring system from its Fisheries Monitoring Centre in London. The vessel monitoring system is used, as part of the sea fisheries enforcement programme, to track the positions of fishing vessels in UK waters. It is also used to track all UK registered fishing vessels globally.

Vessel position reports are received approximately every two hours unless a vessel has a terminal on board which cannot be polled and then it must report once per hour. The data covers all European Commission (EC) countries within British Fisheries Limits and certain Third Countries, e.g., Norway and Faeroes. Vessels used exclusively for aquaculture and operating exclusively within baselines are exempt.

Satellite monitoring data from 2009 was analysed (including UK and non-UK fishing vessels). Sections 12.4 and 12.8 present the satellite data analysis for Project Alpha and Project Bravo respectively.

12.2 *Survey Data (Project Alpha)*

The fishing vessels tracked within 10nm of Project Alpha during the March 2011 and June/July 2011 surveys (40 days) are plotted in Figure 12.1.

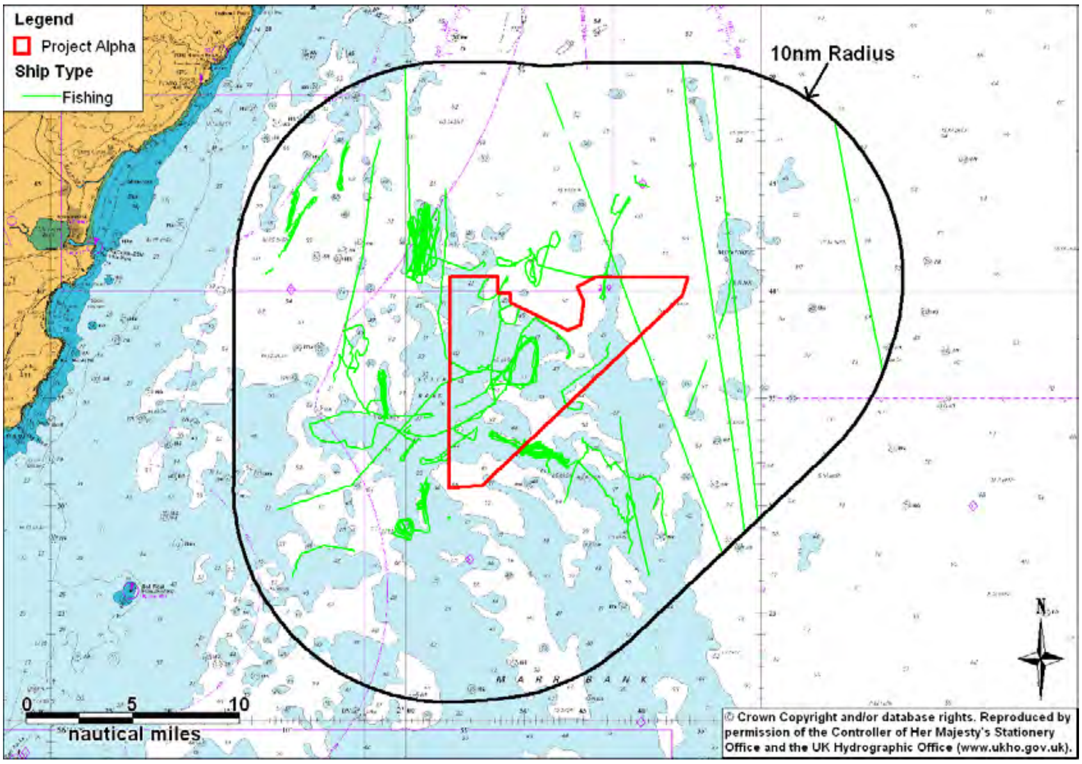

Figure 12.1 Fishing Vessel Tracks within 10nm of Project Alpha (40 Days)

Fishing vessel activity within 10nm of Project Alpha was recorded on AIS (29%) and on radar (71%). Where possible, the vessels tracked by radar were identified by manual observation. However, in most cases it was possible to identify the type of vessel but not the vessel name. Those that were visually identified were primarily scallop dredgers.

Of the 59 fishing vessel tracks recorded, 68% were during the winter survey (March 2011) and 32% were during the summer survey (June/July 2011).

The majority of vessels were recorded either within the Project Alpha site or to the west of the site. An example of a fishing vessel observed within the Project Alpha site during the *Highland Eagle* survey is presented in Figure 12.2.

Figure 12.2 Fishing Vessel *Natalie B* H1074

It should be noted that a proportion of the unidentified vessels tracked on radar (non-AIS) are also likely to be fishing vessels.

12.3 *Sightings Data Analysis (Project Alpha)*

12.3.1 Sightings Density Grid

Figure 12.3 presents a density grid based on the 2005-2009 sightings data to highlight the hot spots of fishing vessel activity within 10nm of Project Alpha. It can be seen that there was generally a higher density of fishing activity to the west of the Project Alpha site.

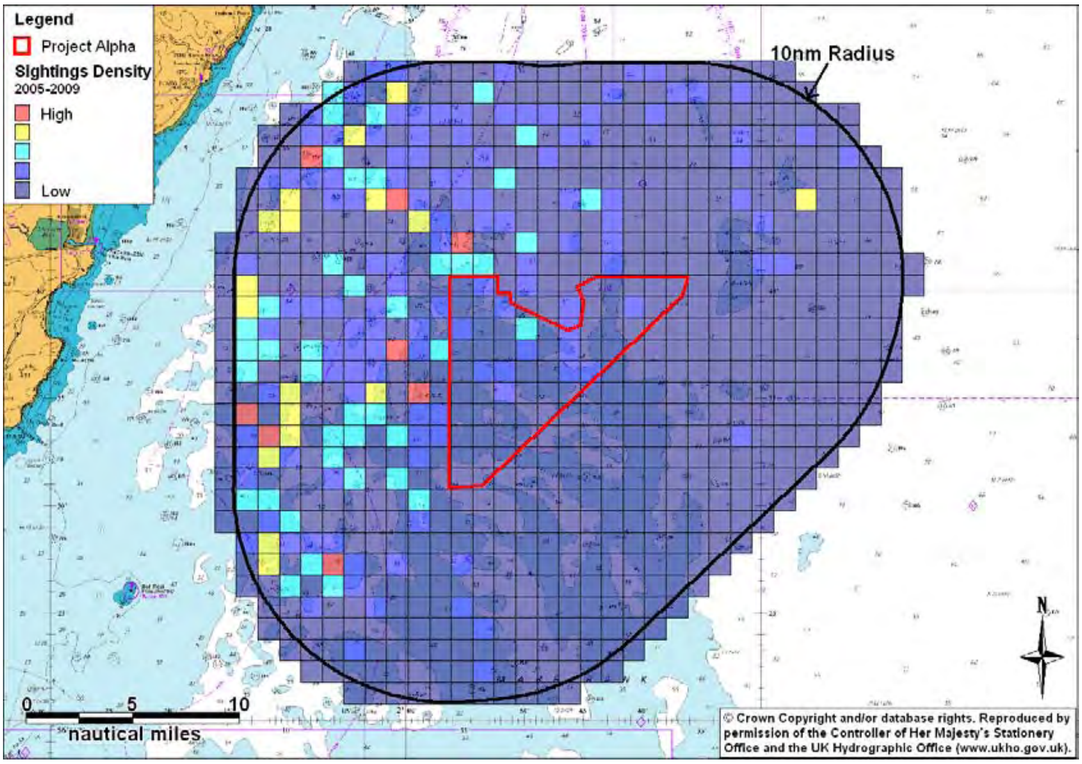

Figure 12.3 Project Alpha Fishing Vessel Sightings Data 2005-2009

12.3.2 Sightings Nationality Analysis

Approximately 97% of fishing vessel sightings within 10nm of the Project Alpha site were UK-registered, with the remaining 3% being registered in The Netherlands.

12.3.3 Sightings Gear Analysis

Using the fishing vessel sightings data, Figure 12.4 presents an analysis of the gear types used by vessels within 10nm of the Project Alpha site. It can be seen that the main fishing methods were scallop dredging (47%), potting (38%) and demersal stern trawling (10%), with around 3% of sightings being unspecified in terms of gear type.

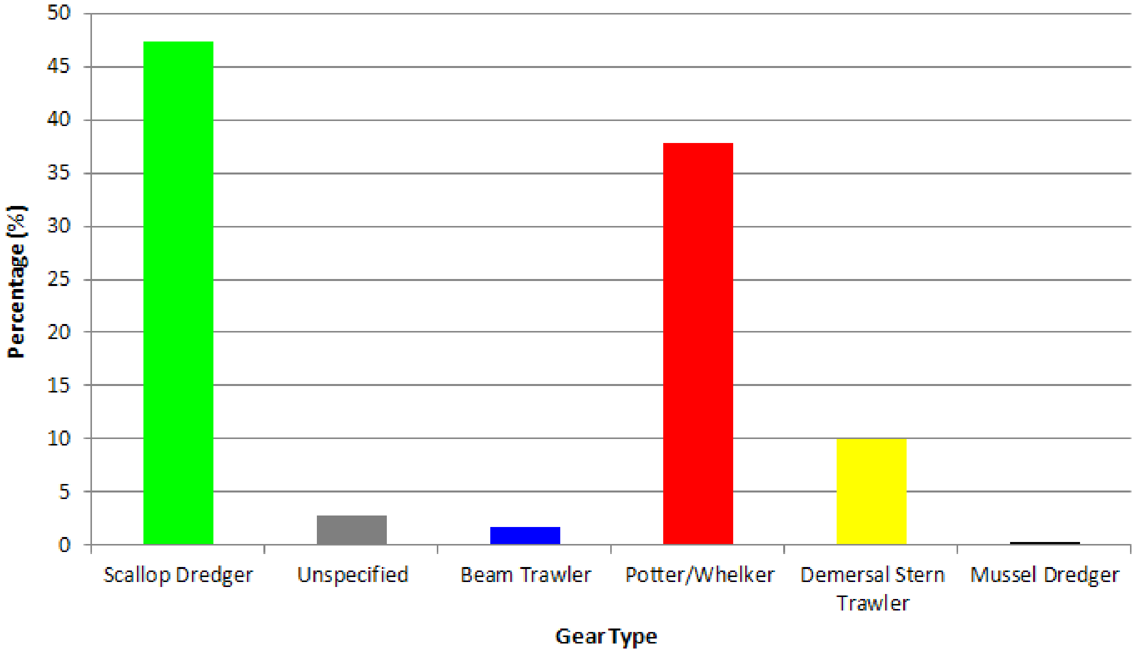

Figure 12.4 Fishing Vessels by Gear Type within 10nm of Project Alpha (2005-2009)

12.3.4 Sightings Activity Analysis

From Figure 12.5, it can be seen that 87% of fishing vessels within 10nm of Project Alpha were engaged in fishing, 6% were steaming (transiting to/from fishing grounds) and <1% were laid stationary (vessels at anchor or pair vessels whose partner vessel is taking the catch whilst the other stands by).

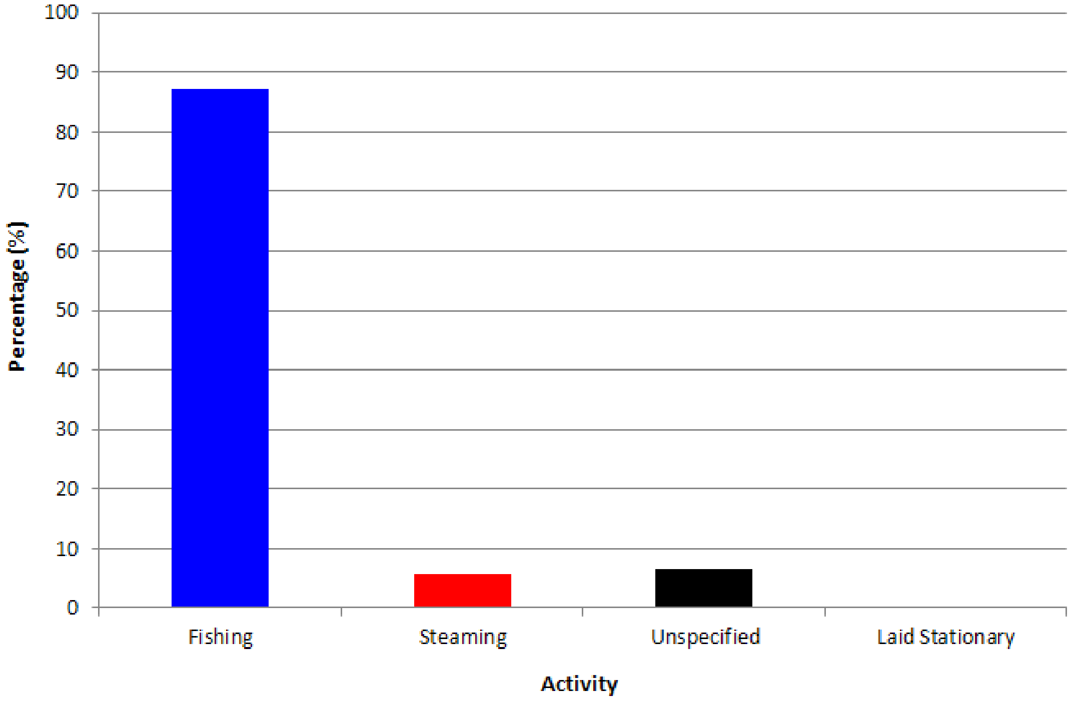

Figure 12.5 Fishing Vessels by Activity within 10nm of Project Alpha (2005-2009)

12.4 *Satellite Data Analysis (Project Alpha)*

12.4.1 Satellite Density Grid

Figure 12.6 presents a density grid based on the 2009 satellite data to highlight the hot spots of fishing vessel activity within 10nm of the Project Alpha site. As was the case with the sightings data, a higher density of fishing activity can be observed to the west of Project Alpha towards the coast.

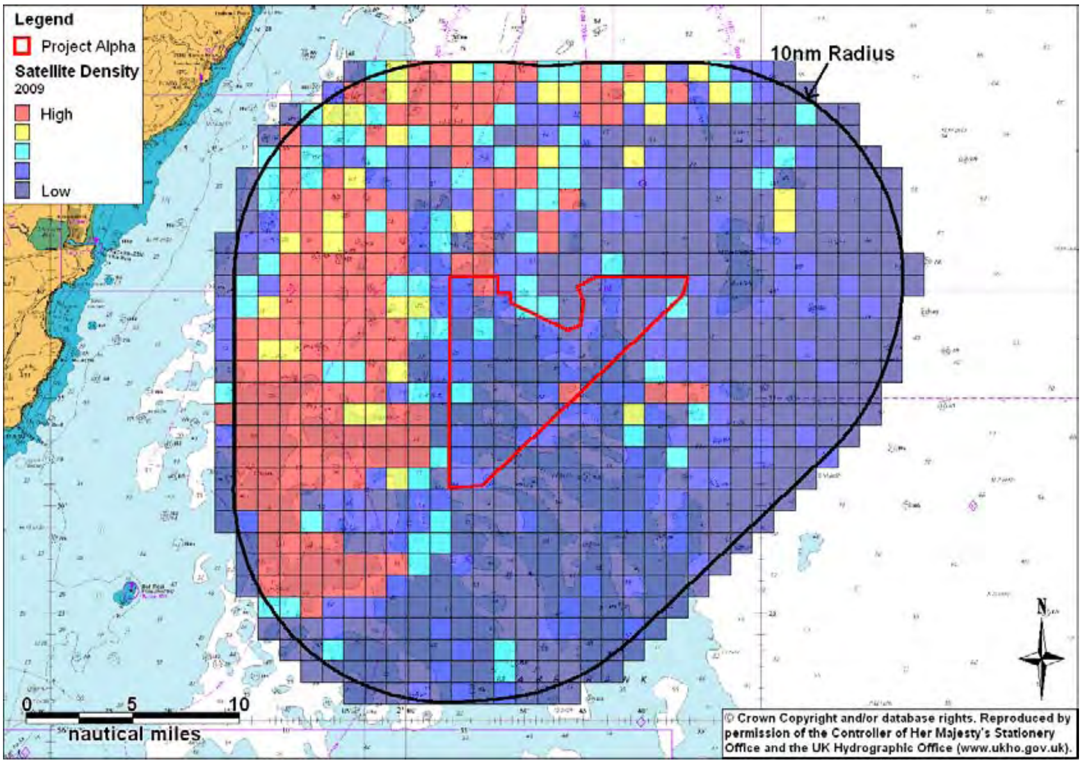

Figure 12.6 Project Alpha Fishing Vessel Satellite Data (2009)

12.4.2 Satellite Nationality Analysis

The vast majority of vessels (>99%) were UK-registered in the 2009 satellite data, with vessels from Denmark, France, The Netherlands and The Faroe Islands also being noted.

12.4.3 Satellite Gear Analysis

Figure 12.7 presents the vessel types (where available) for fishing vessel satellite positions recorded in 2009 within 10nm of the Project Alpha site. 73% of vessels could not be specified. The majority of vessels which could be specified were either scallop dredgers (25%) or demersal stern trawlers (2%).

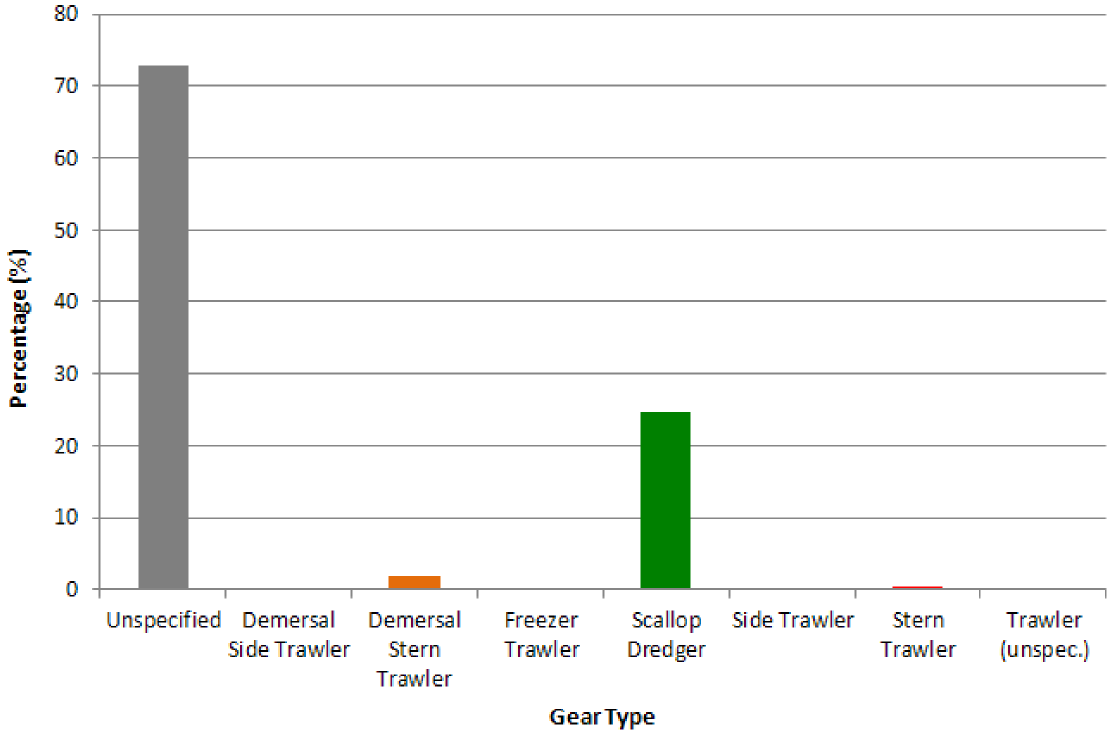

Figure 12.7 Fishing Vessels by Gear Type within 10nm of Project Alpha (2009)

12.5 *Impact Assessment (Project Alpha)*

Based on the current fishing activity in the area, and the assumption that this will continue after Project Alpha has been built, there will be a risk of collision between fishing vessels and wind farm structures. This risk is analysed further in Section 14.3.

There is also potential to affect the navigation of vessels to and from fishing grounds, for example, increased steaming distances and times. This is mainly an issue during the construction and decommissioning stages when there will be a safety zone and hence there may be some increased steaming distances. During operation there should be sufficient spacing between WTGs, no less that five rotor diameters (610m based on a minimum rotor diameter if 122m (see Table 3.3)), for vessels to steam through the site if the conditions are considered suitable. The decision to do this will ultimately lie with the skipper who will be responsible for assessing the risks associated with navigating in proximity to and through an offshore wind farm. This decision is likely to be based on the type and size of fishing vessel and sea, weather and visibility conditions at the time.

Fishing vessels either exiting the wind farm or routeing around it are likely to encounter more commercial vessels and recreational vessels, thus increasing the likelihood of encounters and collision risk.

In terms of fishing gear interaction with cables, demersal trawlers and scallop dredgers were amongst the most abundant vessel types noted in the sightings and satellite data. Both of these fishing methods have the potential to interact with and cause damage to the ECR and array cables due to the gear interaction with the seabed. If fishing gear was to interact with the cables then there is the potential for entanglement which could lead to damage to the cable, the gear and the fishing vessel.

12.6 *Survey Data (Project Bravo)*

The fishing vessels tracked within 10nm of the Project Bravo site during the March 2011 and June/July 2011 surveys (40 days) are plotted in Figure 12.8.

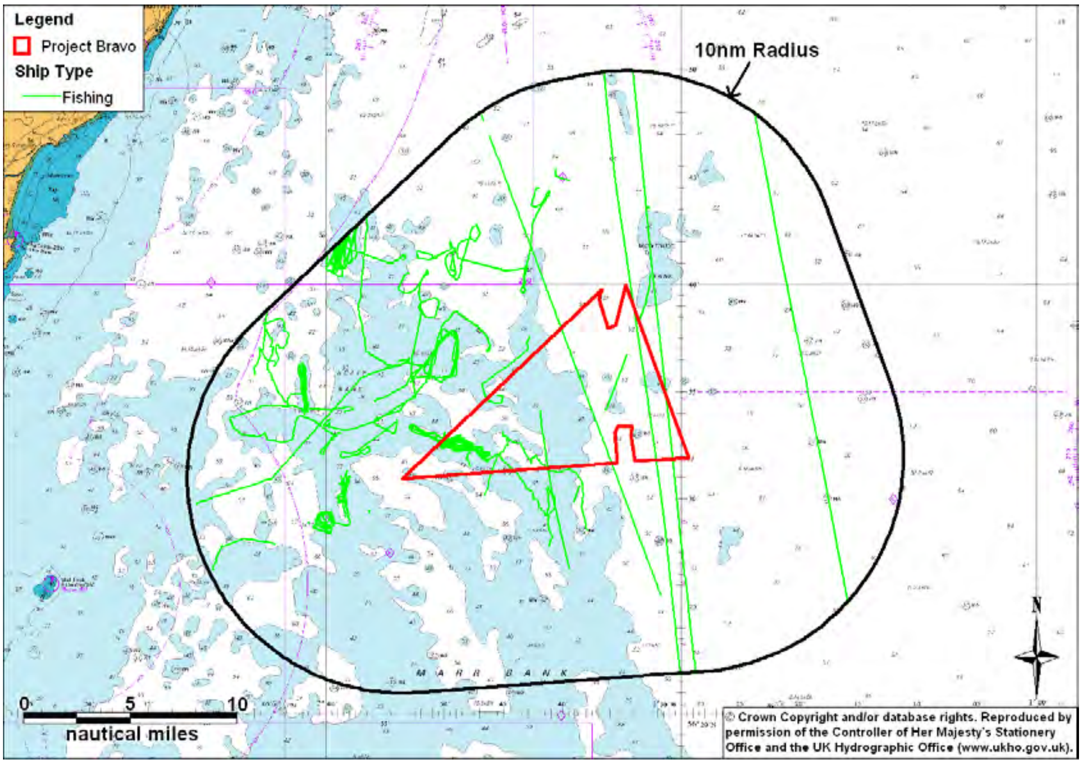

Figure 12.8 Fishing Vessel Tracks within 10nm of Project Bravo (40 Days)

Fishing vessel activity within 10nm of the Project Bravo site was recorded on AIS (13%) and on radar (87%). Where possible, the vessels tracked by radar were identified by manual observation. However, in most cases it was possible to identify the type of vessel but not the vessel name. Those that were visually identified were primarily scallop dredgers.

Of the 46 fishing vessel tracks recorded, 63% were during the winter survey (March 2011) and 37% were during the summer survey (June/July 2011).

The majority of vessels were recorded to the west of Project Bravo or in the south westerly corner of the site. An example of a fishing vessel observed within the Project Bravo site during the *EEMS* survey is presented in Figure 12.9.

Figure 12.9 Fishing Vessel *Jubilee Quest* GY900

12.7 *Sightings Data Analysis (Project Bravo)*

12.7.1 Sightings Density Grid

Figure 12.10 presents a density grid based on the 2005-2009 sightings data to highlight the hot spots of fishing vessel activity within 10nm of Project Bravo. It can be seen that there was generally a higher density of fishing activity to the west of the Project Bravo site towards the coast.

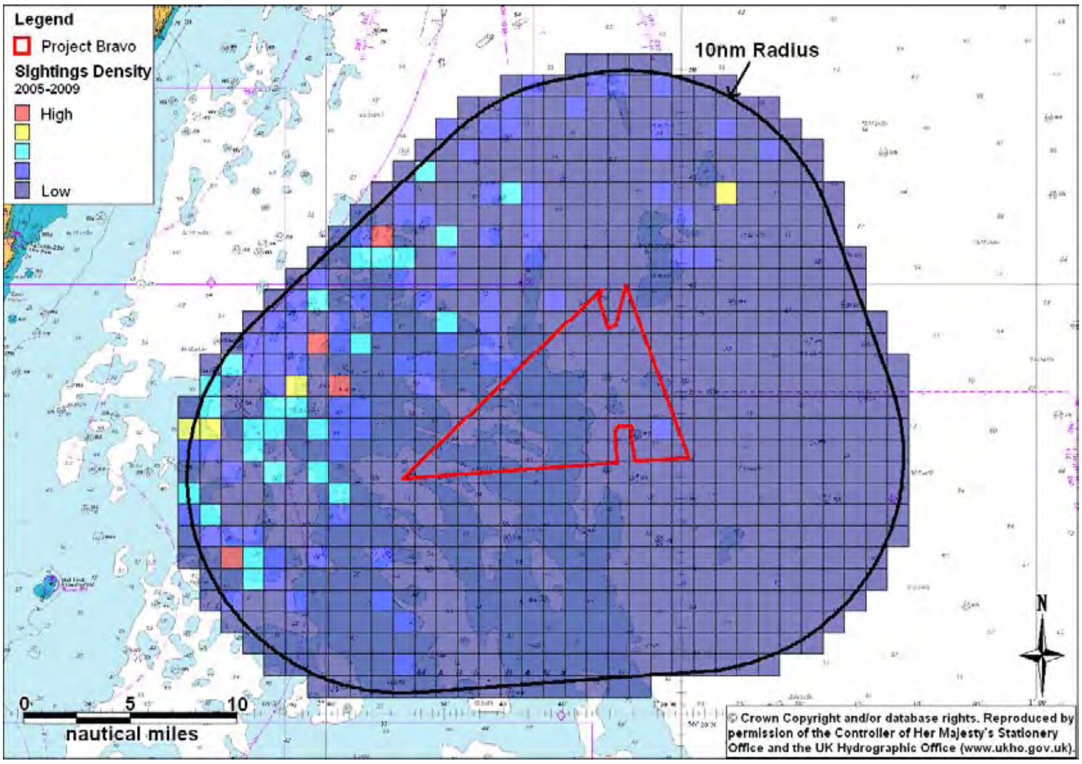

Figure 12.10 Project Bravo Fishing Vessel Sightings Data 2005-2009

12.7.2 Sightings Nationality Analysis

Approximately 97% of fishing vessel sightings within 10nm of the Project Bravo site were UK-registered, with the remaining 3% being registered in The Netherlands.

12.7.3 Sightings Gear Analysis

Using the fishing vessel sightings data, Figure 12.11 presents an analysis of the gear types used by vessels within 10nm of the Project Bravo site. It can be seen that the main fishing methods were scallop dredging (54%) and potting (37%), with around 3% of sightings being unspecified in terms of gear type.

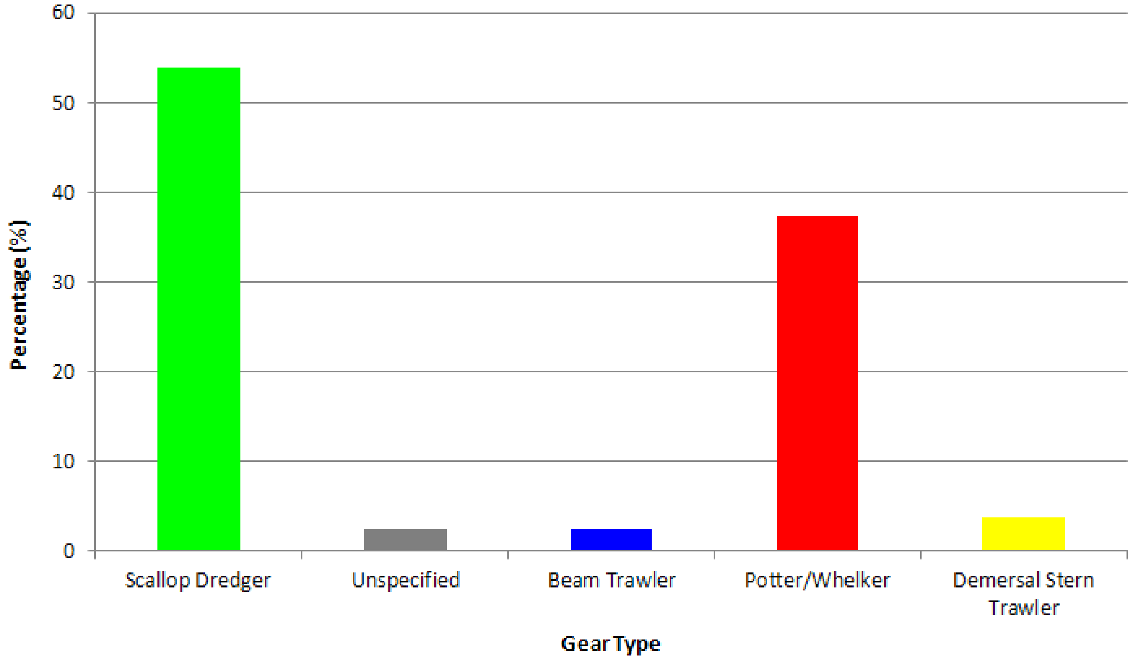

Figure 12.11 Fishing Vessels by Gear Type within 10nm of Project Bravo (2005-2009)

12.7.4 Sightings Activity Analysis

From Figure 12.12, it can be seen that 89% of fishing vessels within 10nm of the Project Bravo site were engaged in fishing and 4% were steaming (transiting to/from fishing grounds).

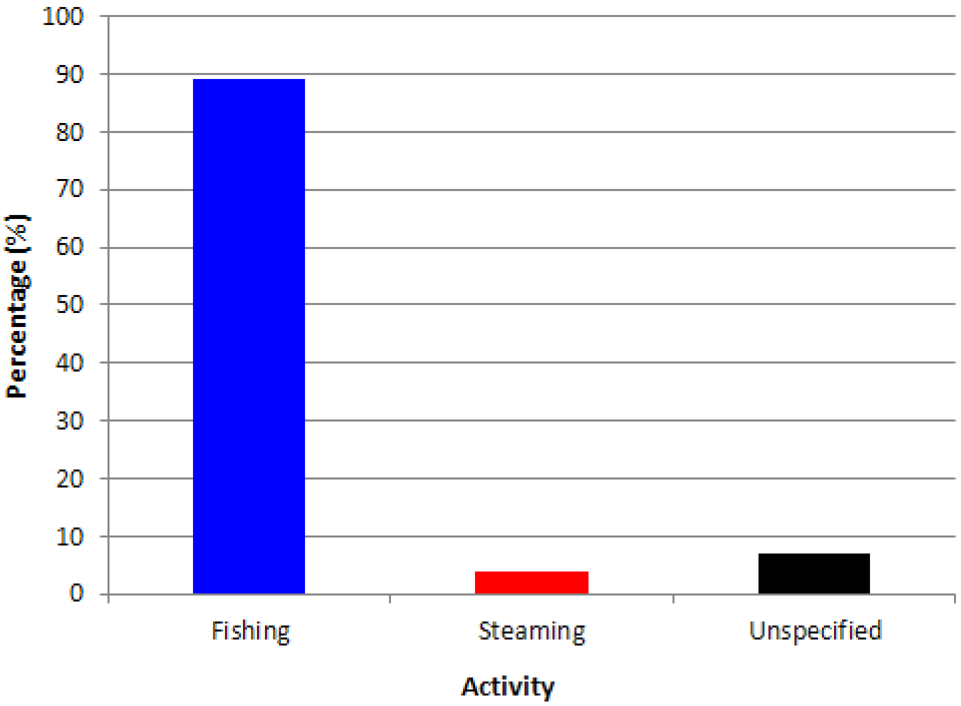

Figure 12.12 Fishing Vessels by Activity within 10nm of Project Bravo (2005-2009)

12.8 *Satellite Data Analysis (Project Bravo)*

12.8.1 Satellite Density Grid

Figure 12.13 presents a density grid based on the 2009 satellite data to highlight the hot spots of fishing vessel activity within 10nm of the Project Bravo site. As was the case with the sightings data, a higher density of fishing activity can be observed to the west of the Project Bravo site towards the coast.

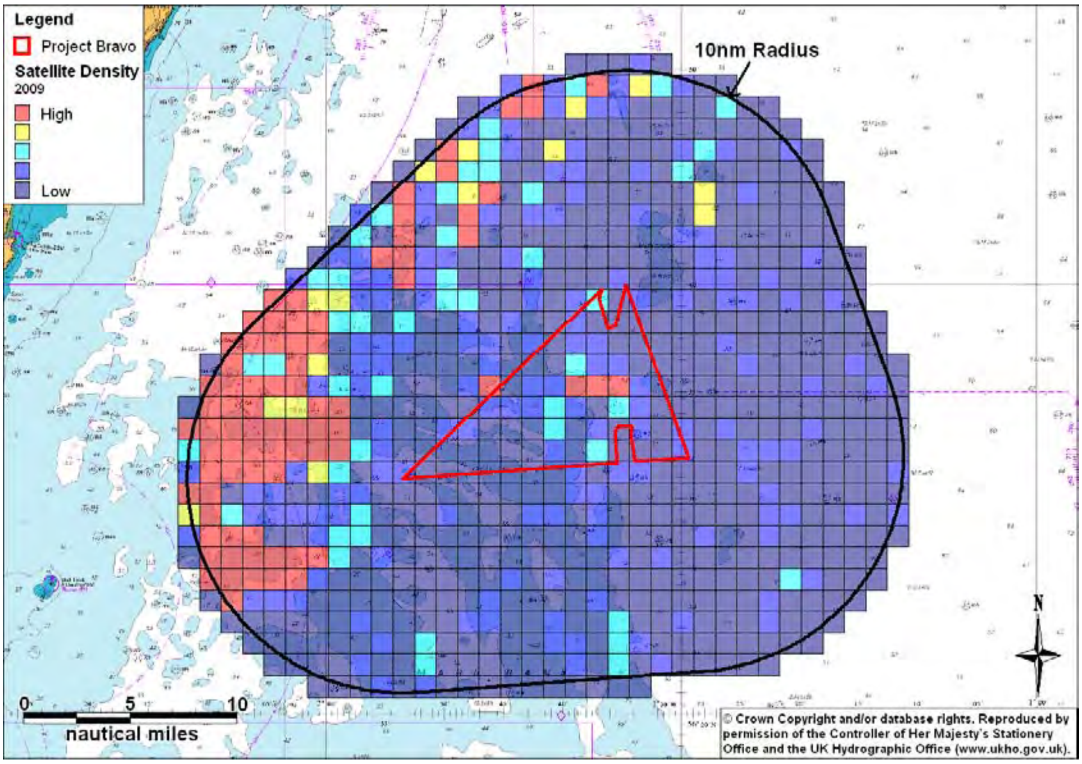

Figure 12.13 Project Bravo Fishing Vessel Satellite Data (2009)

12.8.2 Satellite Nationality Analysis

The vast majority of vessels (98%) were UK-registered in the 2009 satellite data, with vessels from Denmark, France, The Netherlands and The Faroe Islands also being noted.

12.8.3 Satellite Gear Analysis

Figure 12.14 presents the vessel types (where available) for fishing vessel satellite positions recorded in 2009 within 10nm of the Project Bravo site. 73% of vessels could not be specified. The majority of vessels which could be specified were either scallop dredgers (22%) or demersal stern trawlers (3%).

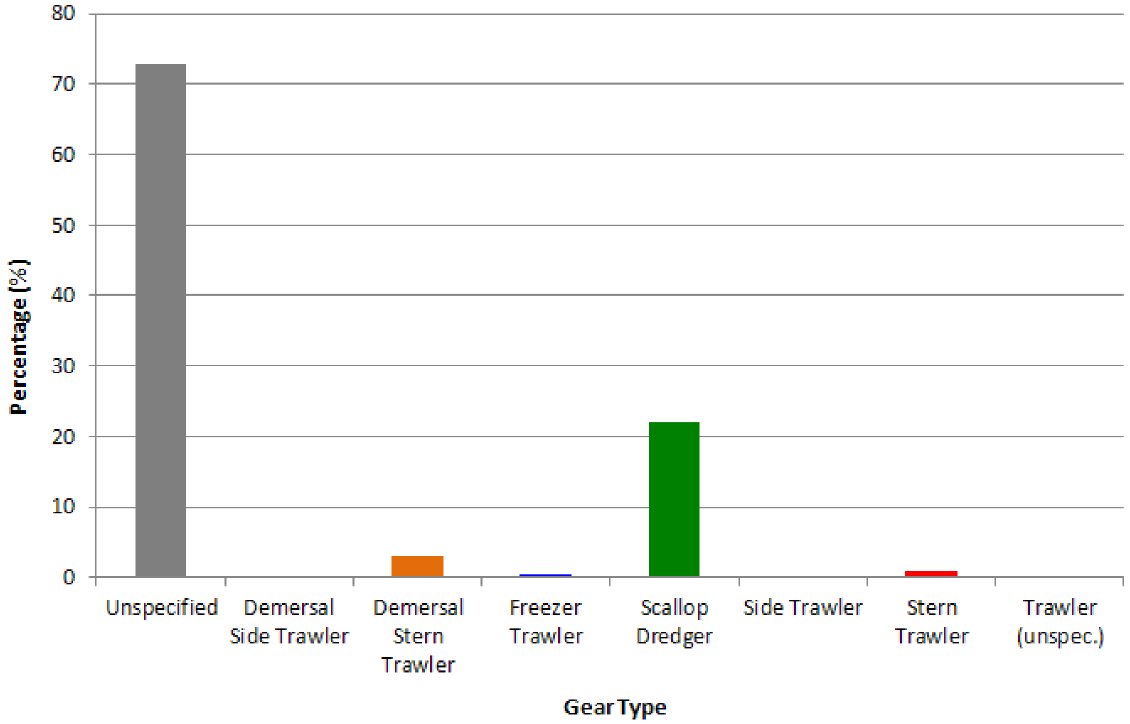

Figure 12.14 Fishing Vessels by Gear Type within 10nm of Project Bravo (2009)

12.9 *Impact Assessment (Project Bravo)*

Based on the current fishing activity in the area, and the assumption that this will continue after Project Bravo has been built, there will be a risk of collision between fishing vessels and wind farm structures. This risk is analysed further in Section 15.3.

The effect on fishing vessels from Project Bravo is the same as that described for Project Alpha in Section 12.5.

12.10 *Commercial Fisheries Assessment*

It is not within the scope of this report to consider the effects of Project Alpha, Project Bravo and the Transmission Asset Project on commercial fisheries. This has been assessed in a separate piece of work as part of the Environmental Impact Assessment (EIA) and can be found in Chapter 14 of the ES (Ref. vii).

13. FORMAL SAFETY ASSESSMENT

13.1 *Introduction*

The International Maritime Organisation (IMO) Formal Safety Assessment (FSA) process (Ref. xiii), as approved by the IMO in 2002 under SC/Circ.1023/MEPC/Circ392, has been applied within this study. This is a structured and systematic methodology based on risk analysis and cost benefit assessment (if applicable). There are five basic steps within this process:

1. Identification of hazards (a list of all relevant accident scenarios with potential causes and outcomes);
2. Assessment of risks (evaluation of risk factors);
3. Risk control options (devising regulatory measures to control and reduce the identified risks);
4. Cost benefit assessment (determining cost effectiveness of risk control measures); and
5. Recommendations for decision-making (information about the hazards, their associated risks and the cost effectiveness of alternative risk control measures).

Figure 13.1 presents a flow diagram of the FSA methodology applied.

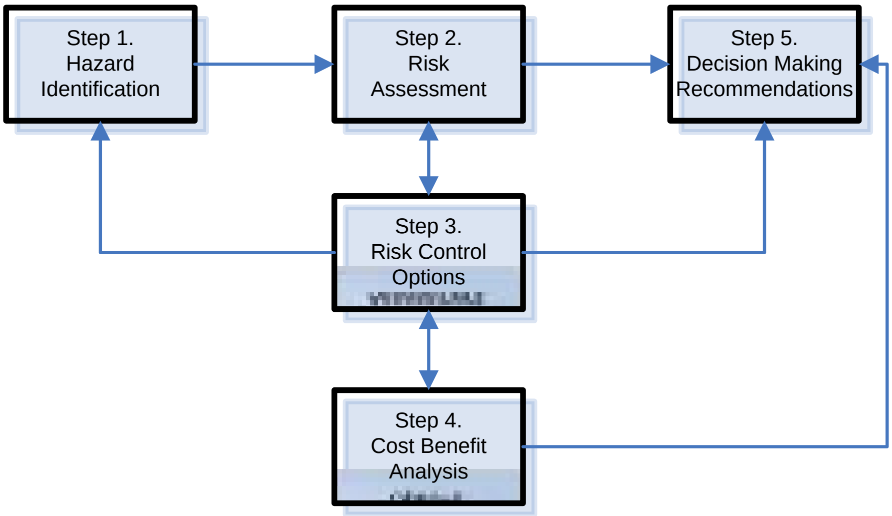

Figure 13.1 Overview of Formal Safety Assessment

As indicated within the IMO FSA guidelines and the DECC guidance on risk assessment methodology for offshore renewable projects (Ref. i), the depth of the assessment should be commensurate with the nature and significance of the problem. Within the assessment of proportionality, consideration was given to both the scale of the development and the magnitude of the risks/navigational impact.

From review it was concluded that the proposed projects are a large scale development with the potential to impact navigational safety. As a result, the content and methods of the risk assessment were responsive to this and included the following:

- Comprehensive hazard log;
- Risk ranking;
- Detailed and quantified NRA for selected hazards;
- Preliminary emergency response overview; and
- Comprehensive risk control/mitigation measures log.

13.2 *Hazard Identification*

A Hazard Review Workshop was held in Dunfermline on 18 January 2012 attended by local stakeholders representing nearby ports and the shipping industry, as outlined in Table 13.1. Note that project boundaries and layouts had not been finalised at the time of the hazard workshop so it was assumed that WTGs could be located anywhere within Phase 1. It should also be noted that two ECR landfall options, at Arbroath and Carnoustie, were also consulted on at the workshop.

Other marine stakeholders including representatives from the CoS, CA, Scottish Canoe Association, RNLI and regular operators were also invited but could not be present on the day. These stakeholders requested if they could be informed of the outputs from the workshop.

Table 13.1 Hazard Review Workshop Attendees

Name	Organisation
Peter Douglas	NLB
Archie Johnstone	NLB
Pete Thomson	MCA
Scott Horsburgh	Marine Scotland
Archie MacCallum	Marine Scotland
Bill Hughes	Kingdom Seafood/FMA Ltd
Sandy Ritchie	Anglo-Scottish Fisherman's Federation
John Watt	Scottish Fisherman's Federation
Ashley Nicholson	Forth Ports Ltd.
Leanne Fisher	Forth Ports Ltd.
Graham Russell	RYA Scotland
Naomi Healey-Cathcart	Seagreen Wind Energy Ltd
Mike Cain	Anatec Ltd
Robert Jones	Anatec Ltd

Name	Organisation
Robert Waterston	URS Infrastructure & Environment UK Limited on behalf of Seagreen

13.3 *Key Findings*

Overall, 16 hazards were reviewed and discussed with stakeholders during the workshop. The full workshop methodology and hazard log can be found in Appendix C The hazard log identifies hazards caused or changed by the introduction of the Phase 1 wind farms and Transmission Asset (including ECR corridor and landfall), the risk associated with the hazard and the controls put in place. For each hazard, risk ranking was carried out separately for the probable and worst case outcomes. The breakdown by tolerability region for the 16 hazards reviewed is presented in Figure 13.2.

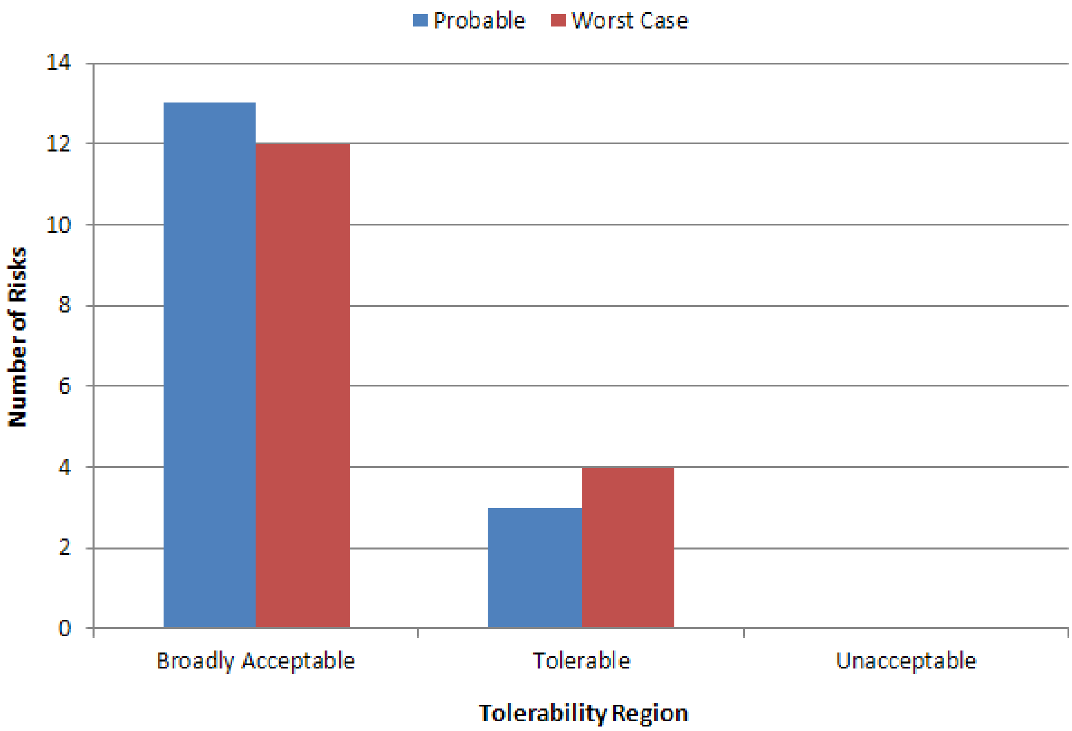

Figure 13.2 Phase 1 Offshore Wind Farms and Transmission Asset Risk Ranking Results

No risks were assessed to be unacceptable. As shown in Figure 13.2, three risks were ranked within the 'Tolerable' region based on the probable outcome whilst four were ranked as 'Tolerable' based on the worst case outcome.

The hazards ranked as tolerable based on probable outcome were:

1. Attendant vessel collision with wind farm structure;

2. Man overboard during transfer to/from WTG or working alongside WTG; and
3. Tanker powered collision with wind farm structures.

The hazard ranked as tolerable based on worst case outcome were:

1. Attendant vessel collision with wind farm structure;
2. Man overboard during transfer to/from WTG or working alongside WTG;
3. Fishing gear interaction with array cabling/export cabling or subsea equipment; and
4. Fishing vessel collision.

Several of the tolerable and worst case outcomes involve third party vessels, but these incidents have a lower likelihood of occurring. In addition, it is not known at this stage if there will be guard vessels used during the construction and decommissioning stages.

Comprehensive minutes recorded at the workshop are presented in Appendix D.

13.4 *Risk Analysis*

Following identification of the key navigational hazards, risk analyses were carried out to investigate selected hazards in more detail. This allowed more attention to be focused upon the high risk areas to identify and evaluate the factors which influence the level of risk with a view to their effective management. Four risk assessments were carried out as per the DECC guidelines:

1. Base case without wind farm and associated infrastructure level of risk;
2. Base case with wind farm and associated infrastructure level of risk;
3. Future case without wind farm and associated infrastructure level of risk; and
4. Future case with wind farm and associated infrastructure level of risk.

The following scenarios were investigated in detail, quantitatively or qualitatively.

Without Wind Farm:

- Vessel-to-vessel collisions.

With Wind Farm

- Vessel-to-vessel collisions;
- Vessel-to-wind farm collisions (powered and drifting); and
- Cable interaction.

All the quantified risk assessments were carried out using Anatec's COLLRISK software which conforms to the DECC methodology as outlined in Annex D3 in the Guidance (Ref. i). In line with this, Anatec makes the declaration that the models used within this work have been validated and are appropriate for the intended use. As required the following have been considered and justified:

- Tuning of parameters;

- Consistency checks;
- Behavioural reasonableness;
- Sensitivity analysis; and
- Comparison with the real world.

The results of the detailed risk analyses for Project Alpha, Project Bravo and the Transmission Asset are presented in Sections 14 and 15 respectively. Where considered appropriate in high risk scenarios, the change in individual and societal risk (based on Potential Loss of Life), as well as the risk of pollution, were calculated and compared to background risk levels in the UK.

13.5 *Risk Mitigation Measures*

A summary of risk mitigation measures is presented in Section 22.

14. RISK ASSESSMENT FOR PROJECT ALPHA

14.1 *Introduction*

This section assesses the risks for Project Alpha which were identified from the hazard review as requiring more detailed assessment. This is divided into without wind farm (pre-installation) and with wind farm (post-installation) risks.

The base case assessment uses the present day vessel activity level identified from the maritime traffic surveys, consultation and other data sources. The future case assessment makes conservative assumptions on marine traffic growth over the 25 year life of the wind farms.

The collision risk modelling is based on the Rochdale Envelope parameters (refer to Section 3 for more details). This section presents the risk assessment results for Project Alpha, with Project Bravo being presented in Section 15. A qualitative risk assessment of the ECR is presented in Appendix A.

14.2 *Without Wind Farm Risk*

14.2.1 Encounters

An assessment of current vessel-to-vessel encounters within 10nm of the Project Alpha site has been carried out by replaying at high-speed, the AIS and radar data collected from *EEMS* (March 2011) and *Highland Eagle* (June/July 2011) during the maritime traffic surveys.

An encounter distance of 1nm has been considered, i.e. two vessels passing within 1nm of each other has been classed as an encounter.

The tracks of vessels encountering one another during the survey periods are presented in Figure 14.1.

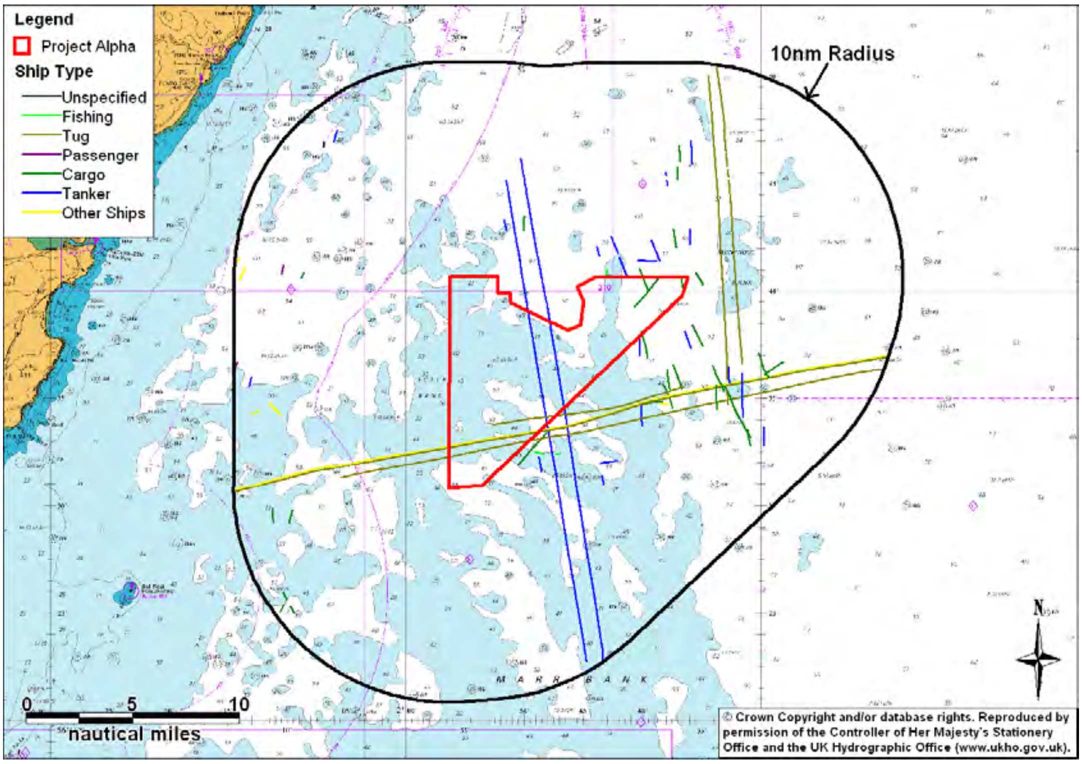

Figure 14.1 Project Alpha Overview of Encounters

Overall it can be seen that the level of encounters in this area is low which is reflective of the levels of shipping and sea room available. The vast majority of encounters occurred in the western section of the 10nm buffer around the Project Alpha site.

Two tankers (*Clipper Burgundy* and *Thames Fisher*) encountered one another passing through the site on 17 July 2011. There were also a number of encounters in the southern part of the site on 27 June 2011.

There were 42 encounters in total within 10nm of the Project Alpha site during the survey period, with an average of one encounter per day. The highest number of encounters was observed on 27 June 2011 where there were seven encounters. Figure 14.2 presents the number of encounters per day.

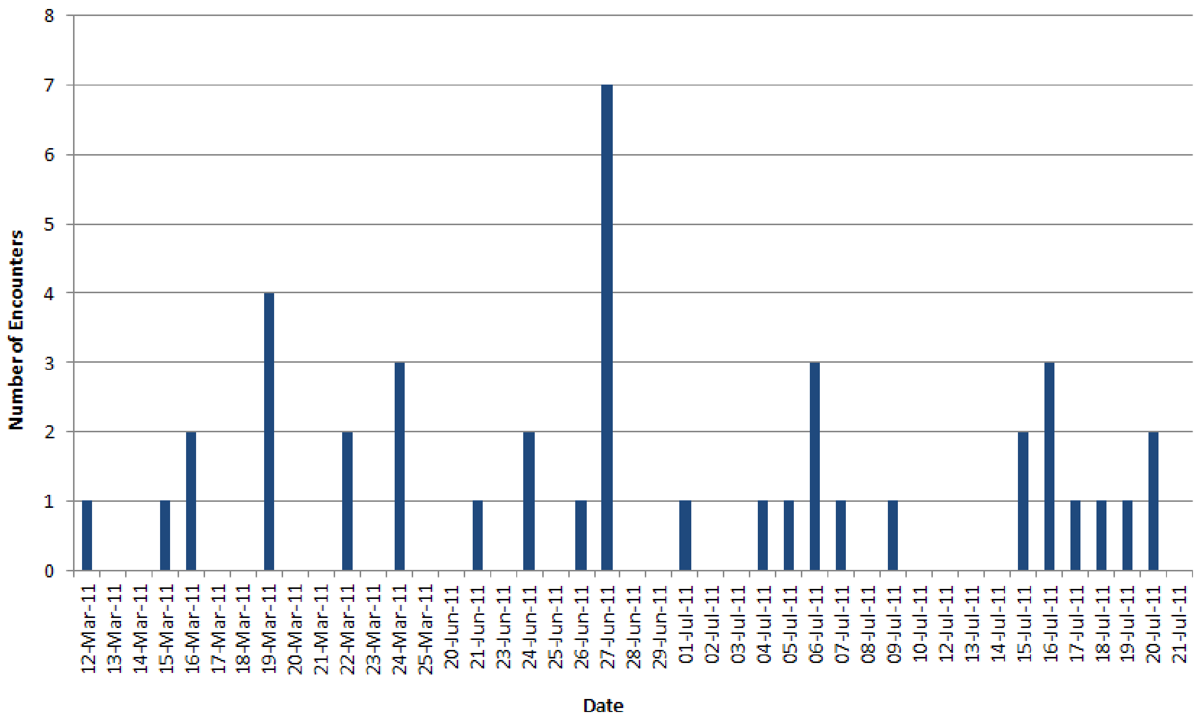

Figure 14.2 Number of Encounters per Day within 10nm of Project Alpha

Figure 14.3 presents the distribution of vessel types involved in encounters.

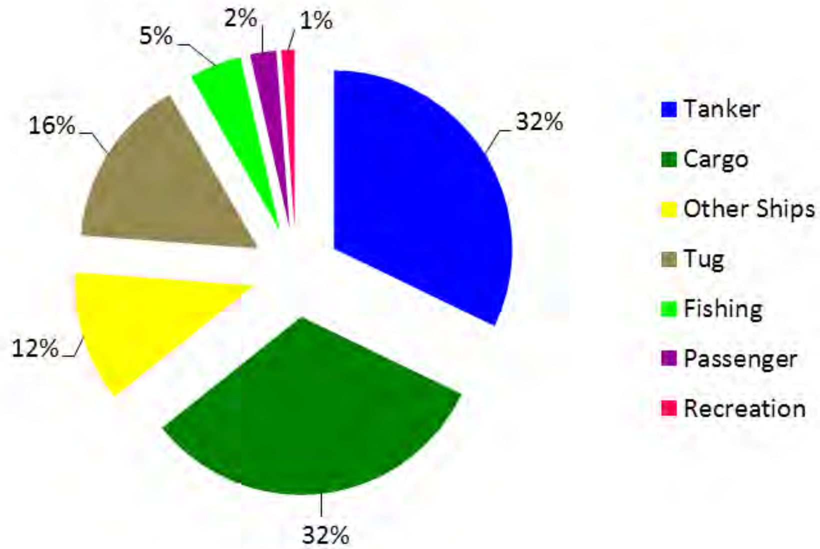

Figure 14.3 Vessel Types Involved in Encounters within 10nm of Project Alpha

It can be seen that the majority of encounters involved tankers (32%) and cargo vessels (32%), with tugs and other ships making up 16% and 12% respectively.

14.2.2 Vessel-to-Vessel Collisions

Based on the existing routeing and encounter levels in the area, Anatec's COLLRISK model has been run to estimate the existing vessel-to-vessel collision risks in the area 10nm around the Project Alpha site. The route positions and widths are based on the survey analysis with the annual densities based on port logs and Anatec's ShipRoutes database, which take seasonal variations into consideration.

Based on the model run for the area, the baseline vessel-to-vessel collision risk level pre-wind farms is in the order of one major collision every 1,899 years.

It is emphasised that the model is calibrated based on major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor incidents. Other incident data from RNLI and MAIB is presented in Section 7. This includes other minor incidents including collisions in port (note that no collisions were reported by MAIB within 10nm of the Project Alpha site).

14.3 *With Wind Farm Risk (Base Case)*

14.3.1 Vessel-to-Vessel Collisions – Change in Risk

The revised routeing pattern following construction of Project Alpha has been estimated based on the review of impact on navigation (see Section 9). It is assumed that vessels will be able to pre-plan their revised passage in advance of encountering the wind farm due to effective mitigation in the form of information distribution about the development to shipping through Notices to Mariners, updated charts, liaison with ports, etc. Fishing vessels may also be displaced from the site to other areas, which could increase the frequency of encounters.

Based on vessel-to-vessel collision risk modelling of the revised traffic pattern, the collision risk was estimated to increase to one major collision every 982 years. The change in collision frequency due to the wind farm development was estimated to be 4.91×10^{-4} per year.

As noted earlier, the model is calibrated based on major incidents at sea which allows for benchmarking but does not cover all incidents, such as minor impacts.

The following potential affects have not been quantified but may indirectly influence the vessel-to-vessel collision risk:

- Radar interference; and
- Visual obscuration when ships approach each other.

The radar interference issue is discussed in Section 17. It is noted that any potential impact is only likely to be a problem during bad visibility and this is mitigated to an extent by the widespread adoption of AIS which will assist vessels in discriminating genuine targets (although AIS is not currently mandatory for smaller vessels, e.g., fishing and recreational vessels).

The visual issue is reviewed in Section 21.2 and is not considered a significant factor for the proposed sites due to its position and orientation relative to the shipping lanes and the other navigational features in the area.

14.3.2 Vessel Collision with Structure

There are two main scenarios for passing vessels colliding with offshore structures such as wind farm structures.

Powered Collision:	Where the vessel is under power but errant
Drifting Collision:	Where a vessel on a passing route experiences propulsion failure and drifts under the influence of the prevailing conditions

Each scenario is assessed below.

Powered Vessel Collision

Based on the ship routeing identified for the area and the anticipated change in routeing due to the Project Alpha site, and assuming effective mitigation in terms of making mariners aware of the wind farm through Notices to Mariners, charts, lights and markings, etc., the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with the Project Alpha site is not considered to be a likely event.

From consultation with the UK shipping industry it is assumed that merchant ships will normally not attempt to navigate between wind farm structures due to the restricted sea room and will be directed by the navigational aids in the area.

Based on modelling the revised vessel routes which are estimated to be used with Project Alpha structures in place and using local metocean data, the frequency of a passing powered vessel collision was estimated to be 2.53×10^{-4} per year (approximately one every 3,947 years). This collision frequency is lower than the historical average of 5.3×10^{-4} per installation-year for offshore installations on the UKCS (1 every 1,900 years).

The individual collision frequencies ranged from 2.15×10^{-4} for the collector station in the north east corner of Project Alpha to 1.33×10^{-15} for a WTG within the wind farm. A plot showing the passing powered collision frequency for each structure in Project Alpha is presented in Figure 14.4.

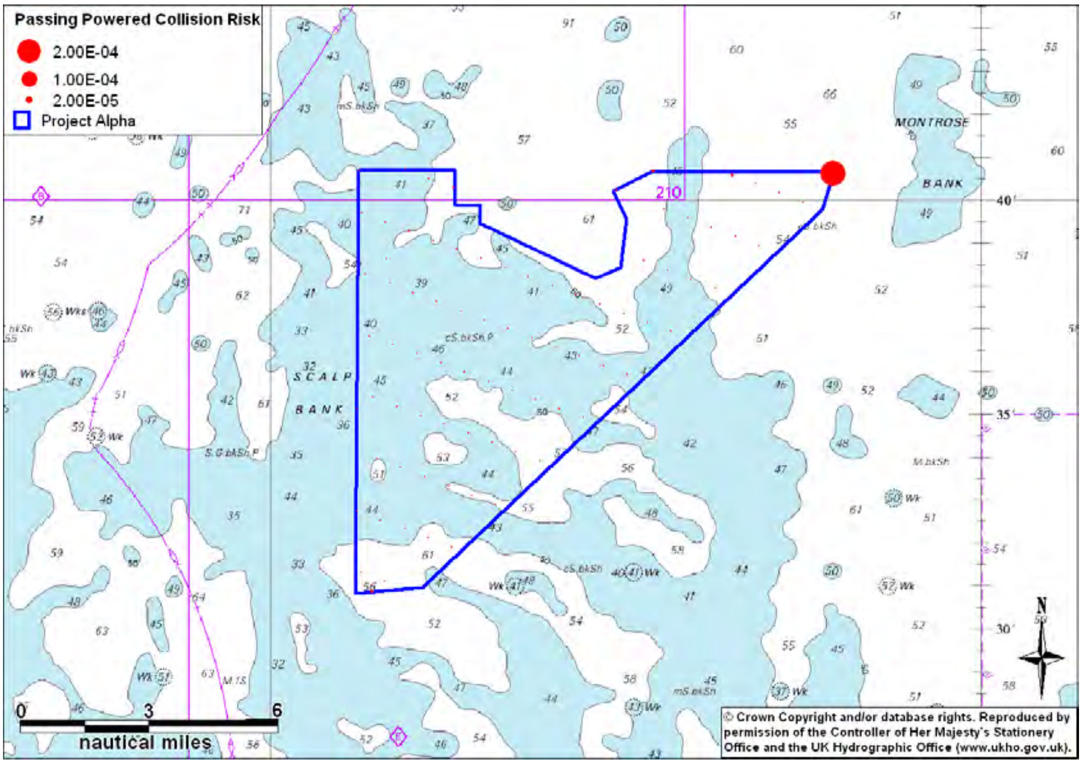

Figure 14.4 Project Alpha Annual Passing Powered Collision Frequency

Drifting Vessel Collision

The risk of a vessel losing power and drifting into the proposed Project Alpha structures was assessed using Anatec's COLLRISK model. This model is based on the premise that propulsion on a vessel must fail before a vessel will drift. The model takes account of the type and size of the vessel, number of engines and average time to repair in different conditions.

The exposure times for a drifting scenario are based on the ship-hours spent in proximity to the proposed wind farms (up to 10nm from perimeter). These have been estimated based on the traffic levels, speeds and revised routeing pattern. The exposure is divided by vessel type and size to ensure these factors, which based on analysis of historical accident data have been shown to influence accident rates, are taken into account within the modelling.

Using this information, the overall rate of breakdown within the area surrounding the wind farm was estimated. The probability of a ship drifting towards a structure and the drift speed are dependent on the prevailing wind, wave and tide conditions at the time of the accident.

The following drift scenarios were modelled:

- Wind;
- Peak Spring Flood Tide; and
- Peak Spring Ebb Tide.

The probability of vessel recovery from drift is estimated based on the speed of drift and hence the time available before reaching the wind farm structure. Vessels that do not recover within this time are assumed to collide.

After running the drifting model for Project Alpha, it was established that flood tide-dominated drift produced the worst case results.

The worst case annual drifting vessel collision frequency for Project Alpha was estimated to be 3.57×10^{-5} per year corresponding to an average of one drifting vessel collision every 27,981 years. Drifting collisions are therefore assessed to be less frequent than powered collisions, which is reflective of historical data. There have been no reported 'passing' drifting ('Not under Command') vessel collisions with offshore installations on the UKCS in over 6,000 operational-years. Whilst a large number of drifting ships have occurred each year in UK waters, most vessels have been recovered in time, e.g., anchored, restarted engines or taken in tow. There have also been a small number of 'near-misses'.

The majority of the drifting vessel collision frequency is associated with the structures on the northern and eastern edges of the wind farm since the currents in the area run in a generally north east to south west direction on the flood.

14.3.3 Fishing Vessel Collision

Anatec's fishing vessel collision risk model (COLLRISK) has been calibrated using fishing vessel activity data along with offshore installation operating experience in the UK (oil and gas) and the experience of collisions between fishing vessels and UKCS offshore installations (published by HSE).

The two main inputs to the model are the fishing vessel density for the area and the structure details. The fishing vessel density in the Project Alpha area was based on fishing vessel sightings data (2005-2009).

Using the above site-specific data as input to the model, the annual fishing vessel collision frequency for Project Alpha was assessed to be 2.05×10^{-2}, which corresponds to an average of one collision every 49 years.

It should be noted that this value assumes the fishing vessel density following the development will remain the same as current levels. However, there is uncertainty in this assumption as a proportion of fishing vessels may avoid the site whilst others may be attracted to the site due to the potential fish aggregating characteristics of the wind farm structures foundations and substructures and their scour material.

It is also noted that this frequency includes for all types of impacts with wind farm structures many of which may be minor due to the slow speeds involved whilst fishing.

14.3.4 Recreational Vessel Collision

There are two main collision hazards from recreational vessels interacting with wind farms:

1. WTG Rotor Blade to Yacht Mast Collision; and
2. Vessel Collision with Main Structures

Blade/Mast Collision

A collision between a WTG blade and the mast of a yacht could result in structural failure of the yacht.

For a blade/mast collision to occur, the air draught of the yacht (from water-line to top of masthead) must be greater than the available clearance under the area swept by the rotating blade.

The planned minimum rotor blade clearance for the WTGs is at least 22m above MHWS, which matches the MCA minimum requirement. Note, as previously mentioned, that the RYA have recommended this requirement is changed from 22m at MHWS to 22m at HAT and this is currently being discussed at the NOREL group. This is the clearance when the blade is in its lowest ('6 o'clock') position. The actual clearance at a given time will depend upon the prevailing tide and wave conditions, i.e., lower clearance at high water and rough seas, greater clearance at low water and calm seas.

To determine the extent to which yacht masts could interact with the rotor blades, details on the air draughts of the IRC fleet are provided in Figure 14.5 based on a fleet size of over 3,000 vessels. IRC is a rating (or 'handicapping' system) used Worldwide which allows boats of different sizes and designs to race on equal terms. The UK IRC fleet, although numerically only a small proportion of the total number of sailing yachts in the UK, is considered representative of the range of modern sailing boats in general use in UK waters.

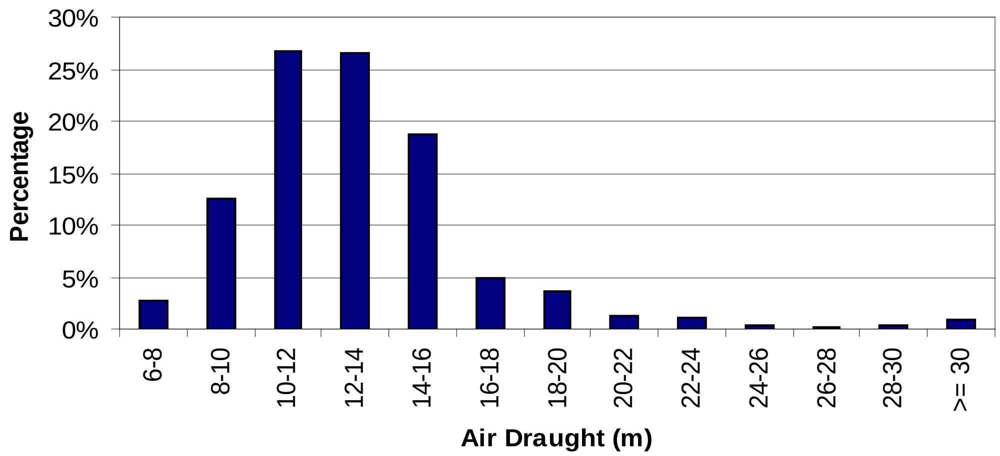

Figure 14.5 Air Draught Data – IRC Fleet (2002)

From this data, just under 3% of boats have air draughts exceeding 22m. Therefore, only a fraction of vessels could potentially be at risk of dismasting if they were directly under a rotating blade in the worst-case conditions.

It is further noted that the wind farm will be designed and constructed to satisfy the requirement of the MCA in respect of control functions and safety features, as specified in the MCA standards (Ref. ii).

The most likely reason for the Emergency Management System being ineffective is considered to be the mariner failing to alert the Coastguard either directly or indirectly using Very High Frequency (VHF), mobile phone, flares, etc. It is noted that very large yachts, which are the only boats that could potentially interact with the rotor blades, are also most likely to be equipped with VHF radio and other safety equipment.

Based on the information presented in this section, the risk of dismasting of a yacht by a rotating blade of a WTG in the Project Alpha site is assessed to be minimal, and has not been further quantified.

Vessel/Structure Collision

In good conditions the wind farm should be visible, especially as most recreational vessel activity occurs during daylight hours. In this case, vessels, if competently skippered, will be able to navigate safely to avoid the structures. Even if a vessel were to get into difficulty, most should be able to keep clear of the structures or anchor/moor if necessary to avoid drifting closer to the wind farm whilst they fix the problem or call for assistance.

The main risk of collision is considered to be in adverse weather conditions, especially poor visibility, where a small craft could fail to see the wind farm and inadvertently end up closer than intended.

If there were poor visibility combined with adverse weather and/or strong tides, the vessel may not be able to anchor.

The risk of small craft being in the area during adverse weather is reduced by the fact that most craft are fitted with radio receivers and VHF so will be able to listen to regular broadcasts of the weather forecast by the British Broadcasting Corporation (BBC) and Coastguard. It is also standard practice for local clubs to post weather forecasts on notice boards.

Given the ready availability of weather forecasts and growing use of Global Positioning System (GPS), the risk of a vessel being in proximity to the wind farm in adverse weather is considered to be low but not negligible. This is supported by the maritime traffic survey which recorded no recreational craft during the winter survey. In the scenario of a vessel being out in adverse weather, they may be unable to make their way from the wind farm and should alert the Coastguard using mobile phone, VHF or flares to avoid the risk of collision.

To minimise the risk of collision in this worst-case scenario, mitigation in line with regulator guidance will be put in place. It will be ensured, consistent with the requirements of NLB, that the structures are marked in such a way as to enhance the prospect of visual observation by passing recreational craft even in adverse conditions.

The Operator will also ensure notification of the development to the recreational craft community is widespread and effective throughout all stages. Information will be promulgated to yacht clubs, marinas and harbour masters.

These measures mean that whilst the collision risk cannot be completely eliminated it will be reduced to a level as low as reasonably practicable. In terms of consequences, most collisions with the wind farm structures should be relatively low speed and hence low energy. The wind farm structures will be equipped with access ladders for use in emergency situations, placed in the optimum position taking into account the prevailing wind, wave and tidal conditions, as required by the MCA. This should provide a place of safety/refuge until such time as the rescue services arrive.

14.4 *Cable Interaction*

There is the potential for fishing vessels and anchoring commercial vessels to interact with array and export cables if not sufficiently buried or protected, leading to cable damage and a safety risk to the vessel.

Array cables will be buried or trenched (plough or jet) where seabed conditions allow and projected by rock or mattress protection where burial is not possible. If buried, the cables will be buried to a depth of 0.5-2.1m and the estimated trench width is 0-3m. Rock or mattress protection will have a maximum height of 1m and a maximum width of 7m.

A qualitative risk assessment for the export cable which details the baseline vessel activity, anchoring activity, the risks to the cable and mitigation measures is presented in Appendix A.

14.5 *Future Case Level of Risk*

14.5.1 Shipping

Data published by DfT (Ref. xiv) indicates that, over recent years, the ship arrivals at the ports closest to the Phase 1 wind farms (Aberdeen, Montrose, Dundee and Forth) have gradually decreased (see Figure 14.6).

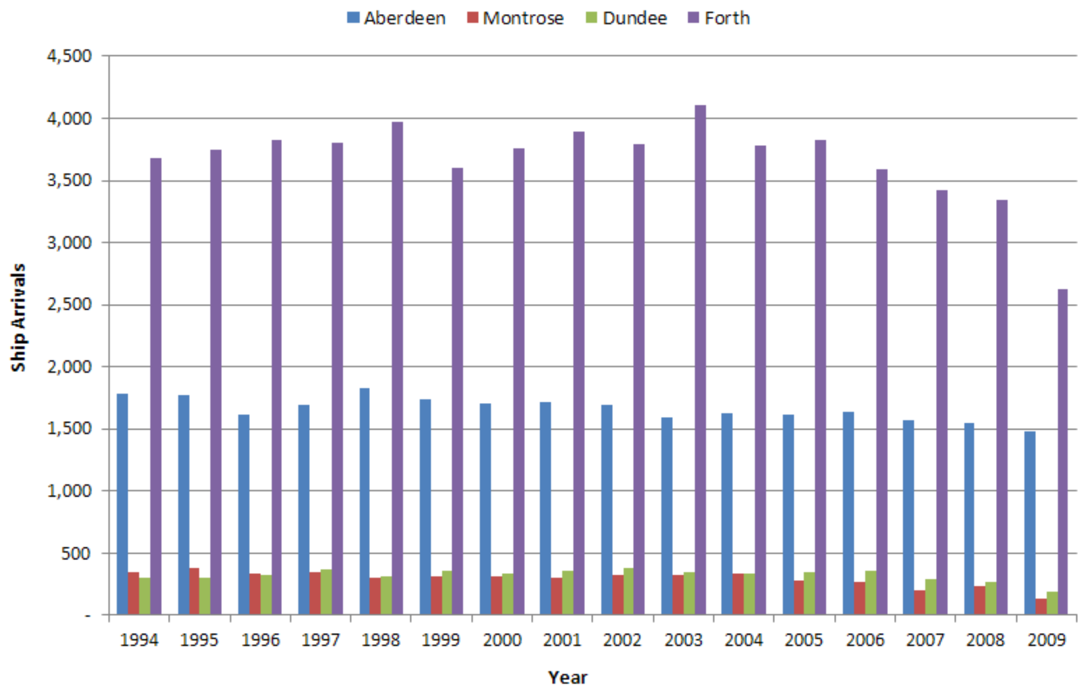

Figure 14.6 Vessel Arrivals in Main Ports on East Coast of Scotland (1994-2009)

The tonnage at these ports has varied considerably over the recent years with a slight decrease observed in the last recorded period (2008-2009) (see Figure 14.7).

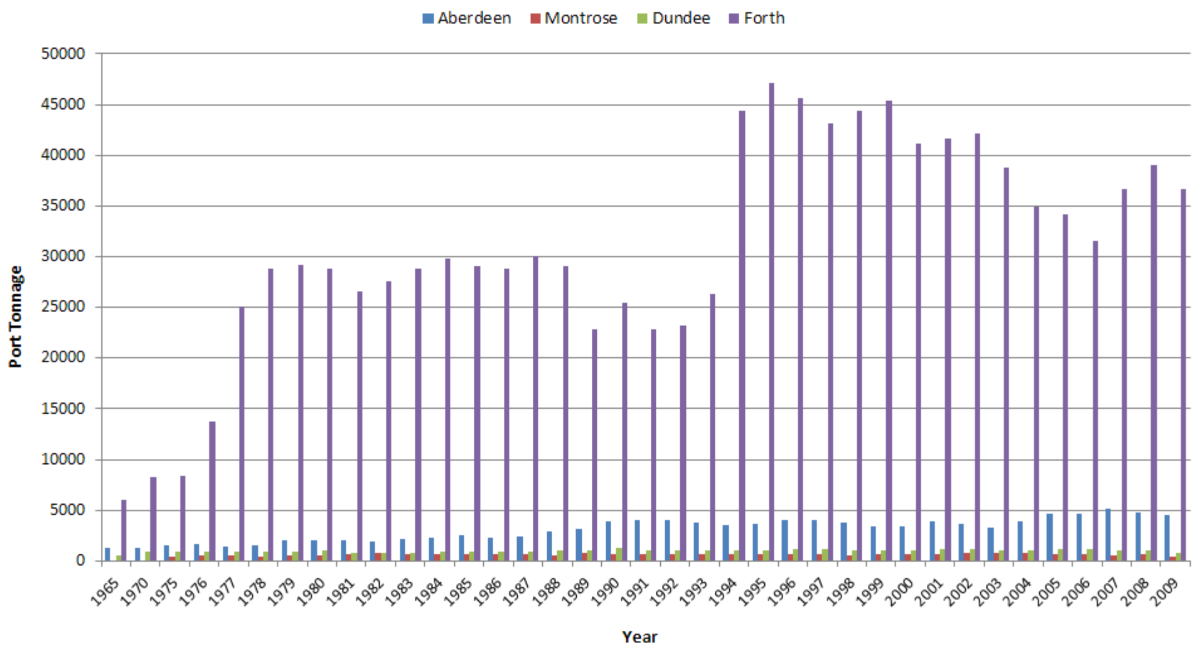

Figure 14.7 Total Tonnage through Main Ports on East Coast of Scotland (1965-2009)

A port expansion at Leith and the creation of an International Container Terminal at Rosyth have been proposed, as well as developments associated with the wind farms in the area (such as the port expansions at Dundee). A potential growth in shipping movements of 10% was estimated over the life of the wind farm which is assumed to be 25 years.

14.5.2 Fishing

The Commercial Fisheries Assessment (Ref. xv) considered the potential changes to the fishing baseline over the life of the development. It is recognised this is a speculative exercise due to numerous unpredictable, direct and indirect factors which can materially affect fisheries. Regarding future fishing practices, the commercial fisheries assessment has stated that scallop gear allowances may be revised to align with those in place in English waters, the whitefish fishery in the region is unlikely to be resumed, a small scale sprat fishery may be created and there is the possibility for the sandeel fishery on the Wee Bankie to open again if the species recovers to a sufficient level.

The future level of activity has been assumed to increase by 10% over 25 years compared to current levels.

14.5.3 Recreational

In terms of recreational vessel activity, there are no major developments known of that will increase the activity of these vessels in the area.

Based on the discussion presented, the future level of activity has been assumed to increase by 10% compared to the current, low levels.

14.5.4 Collision Probabilities

The potential increase in vessel activity levels would increase the probability of vessel-to-structure collisions (both powered and drifting). Whilst in reality the risk would vary by vessel type, size and route, it is roughly estimated this would lead to a linear 10% increase in the base case collision risks.

The increased activity would also increase the probability of vessel-to-vessel encounters and hence collisions. Whilst this is not a direct result of the proposed wind farm, the increased congestion caused by the site and potential displacement of traffic in the area may have an influence. Again a 10% overall increase is assumed.

14.6 *Risk Results Summary*

The base case and future case annual levels of risk without and with the Project Alpha proposal are summarised in Table 14.1. The change in risk is also shown, i.e., the estimated collision risk with the wind farm minus the estimated baseline collision risk without the wind farm (which is zero except for vessel-to-vessel collisions).

Table 14.1 Summary of results – Project Alpha

Collision Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	2.53E-04	2.53E-04	--	2.79E-04	2.79E-04
Passing Drifting	--	3.57E-05	3.57E-05	--	3.93E-05	3.93E-05
Vessel-to-Vessel	5.27E-04	1.02E-03	4.91E-04	5.80E-04	1.12E-03	5.40E-04
Fishing	--	2.05E-02	2.05E-02	--	2.26E-02	2.26E-02
Total	5.27E-04	2.18E-02	2.13E-02	5.80E-04	2.40E-02	2.34E-02

The overall annual level of collision risk is estimated to increase due to the proposed Project Alpha development by approximately 1 in 47 years (base case) and 1 in 43 years (future case). The vast majority of this risk is from fishing vessel collisions.

14.7 *Consequences*

The probable outcomes for the majority of hazards are expected to be minor. However, the worst case outcomes could be severe, including events with potentially multiple fatalities.

A collision involving a larger ship is likely to result in collapse of a WTG with limited damage to the ship. Breach of a ship's fuel tank is considered unlikely and in the case of vessels carrying hazardous cargoes, e.g., tanker or gas carrier, the additional safety features associated with these vessels would further mitigate the risk of pollution (for example double hulls). Similarly, in a drifting collision the proposed wind farm structures are likely to absorb the majority of the impact energy, with some energy also being retained by the vessel in terms of rotational movement (glancing blow).

In terms of smaller vessels such as fishing and recreational craft, the worst case scenario would be risk of vessel damage leading to foundering of the vessel and potential loss of life.

A quantitative assessment of the potential consequences of collision due to the proposed wind farm is presented in Appendix G This applies the site-specific collision frequency results presented above with estimated outcomes in terms of fatalities on-board and oil pollution from the vessel based on research into historical collision incidents (MAIB, ITOPF, etc.).

The annual increase in Potential Loss of Life (PLL) due to the impact of Project Alpha is estimated to be as follows:

- Base Case PLL: 7.13E-04 fatalities per year
- Future Case PLL: 7.85E-04 fatalities per year

The overall increase in PLL estimated due to the development is 7.13×10^{-4} fatalities per year (base case), which equates to one additional fatality in 1,402 years. This is a small change compared to the MAIB statistics which indicate an average of 29 fatalities per year in UK territorial waters.

In terms of individual risk to people, the incremental increase for commercial ships (in the region of 10^{-9}) is very low compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

Similarly, for fishing vessels, whilst the change in individual risk attributed to the development is higher than for commercial vessels (in the region of 10^{-5}), it is low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

Therefore, the incremental increase in risk to both people and the environment caused by Project Alpha is estimated to be low.

15. RISK ASSESSMENT FOR PROJECT BRAVO

15.1 *Introduction*

This section assesses the risks for Project Bravo which were identified from the hazard review as requiring more detailed assessment. This is divided into without wind farm (pre-installation) and with wind farm (post-installation) risks.

The base case assessment uses the present day vessel activity level identified from the maritime traffic surveys, consultation and other data sources. The future case assessment makes conservative assumptions on marine traffic growth over the 25 year life of the wind farm.

The collision risk modelling is based on the Rochdale Envelope (refer to Section 3 for more details). This section presents the risk assessment results for the Project Bravo site, with Project Alpha being presented in Section 14. A qualitative risk assessment of the ECR is presented in Appendix A.

15.2 *Without Wind Farm Risk*

15.2.1 Encounters

An assessment of current vessel-to-vessel encounters within 10nm of the Project Bravo site has been carried out by replaying at high-speed, the AIS and radar data collected from *EEMS* (March 2011) and *Highland Eagle* (June/July 2011) during the maritime traffic surveys.

An encounter distance of 1nm has been considered, i.e. two vessels passing within 1nm of each other has been classed as an encounter.

The tracks of vessels encountering one another during the survey periods are presented in Figure 15.1.

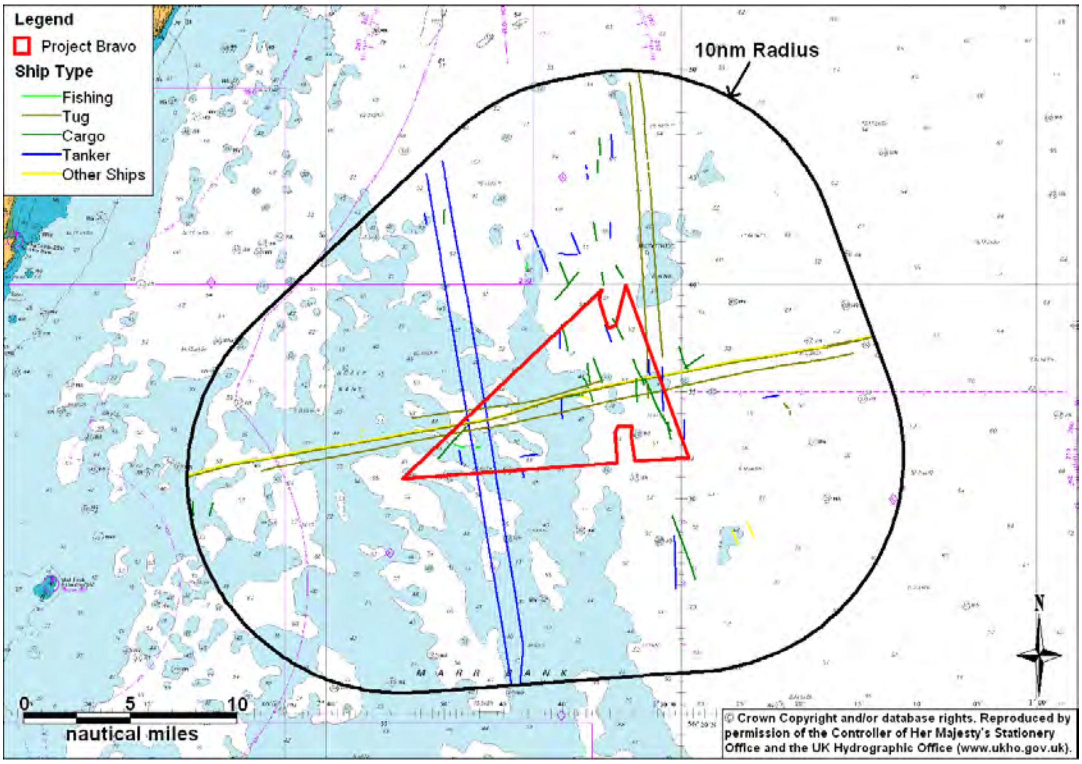

Figure 15.1 Project Bravo Overview of Encounters

Overall it can be seen that the level of encounters in this area is low which is reflective of the levels of shipping and sea room available. A number of encounters occurred within the boundary of the Project Bravo site, with the most activity in the western part of the site where traffic routes are the most dense.

In the eastern part of the site, two tankers (*Clipper Burgundy* and *Thames Fisher*) encountered one another passing through the site on 17 July 2011.

There were 40 encounters in total within 10nm of the Project Bravo site during the survey period, with an average of one encounter per day. The highest number of encounters was observed on 27 June 2011 where there were 10 encounters. Figure 15.2 presents the number of encounters per day.

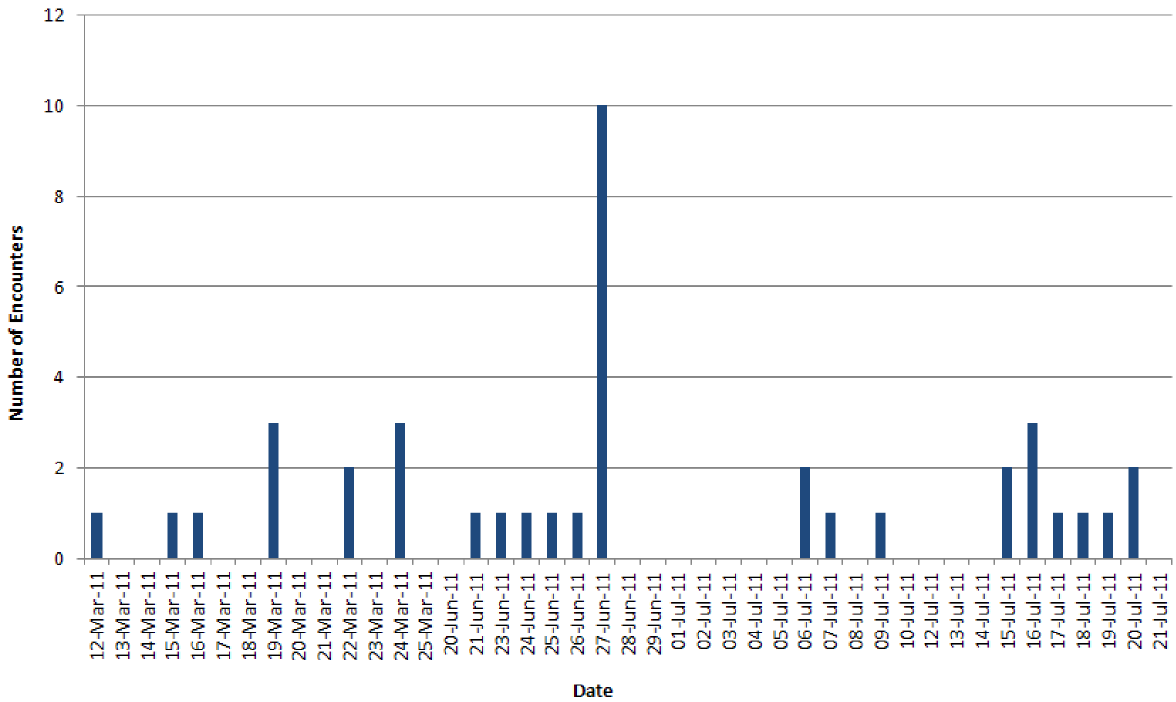

Figure 15.2 Project Bravo Number of Encounters per Day

Figure 15.3 presents the distribution of vessel types involved in encounters.

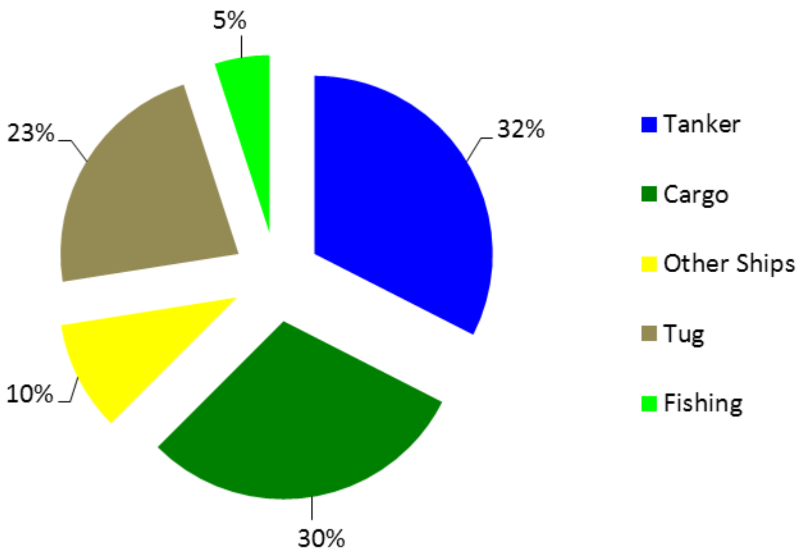

Figure 15.3 Vessel Types Involved in Encounters

It can be seen that the majority of encounters involved tankers (32%) and cargo vessels (30%), with tugs and other ships making up 23% and 10% respectively.

15.2.2 Vessel-to-Vessel Collisions

Based on the existing routeing and encounter levels in the area, Anatec's COLLRISK model has been run to estimate the existing vessel-to-vessel collision risks in the area 10nm around the Project Bravo site. The route positions and widths are based on the survey analysis with the annual densities based on port logs and Anatec's ShipRoutes database, which take seasonal variations into consideration.

Based on the model run for the area, the baseline vessel-to-vessel collision risk level pre-wind farms is in the order of one major collision every 3,094 years.

It is emphasised that the model is calibrated based on major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor incidents. Other incident data from RNLI and MAIB is presented in Section 7. This includes other minor incidents including collisions in port (note that no collisions were reported by MAIB within 10nm of the Project Bravo site).

15.3 *With Wind Farm Risk (Base Case)*

15.3.1 Vessel-to-Vessel Collisions – Change in Risk

The revised routeing pattern following construction of Project Bravo has been estimated based on the review of impact on navigation (see Section 10). It is assumed that vessels will be able to pre-plan their revised passage in advance of encountering the wind farm due to effective mitigation in the form of information distribution about the development to shipping through Notices to Mariners, updated charts, liaison with ports, etc. Fishing vessels may also be displaced from the site to other areas, which could increase the frequency of encounters.

Based on vessel-to-vessel collision risk modelling of the revised traffic pattern, the collision risk was estimated to increase to one major collision every 1,561 years. The change in collision frequency due to the wind farm development was estimated to be 3.17×10^{-4} per year.

As noted earlier, the model is calibrated based on major incidents at sea which allows for benchmarking but does not cover all incidents, such as minor impacts.

The following potential affects have not been quantified but may indirectly influence the vessel-to-vessel collision risk:

- Radar interference; and
- Visual obscuration when ships approach each other.

The radar interference issue is discussed in Section 17. It is noted that any potential impact is only likely to be a problem during bad visibility and this is mitigated to an extent by the widespread adoption of AIS which will assist vessels in discriminating genuine targets (although AIS is not currently mandatory for smaller vessels, e.g., fishing and recreational vessels).

The visual issue is reviewed in Section 21.2 and is not considered a significant factor for the proposed sites due to its position and orientation relative to the shipping lanes and the other navigational features in the area.

15.3.2 Vessel Collision with Structure

There are two main scenarios for passing vessels colliding with offshore structures such as wind farm structures:

Powered Collision:	Where the vessel is under power but errant
Drifting Collision:	Where a vessel on a passing route experiences propulsion failure and drifts under the influence of the prevailing conditions

Each scenario is assessed below.

Powered Vessel Collision

Based on the ship routeing identified for the area and the anticipated change in routeing due to the Project Bravo site, and assuming effective mitigation in terms of making mariners aware of the wind farm through Notices to Mariners, charts, lights and markings, etc., the frequency of an errant vessel under power deviating from its route to the extent that it comes into proximity with the Project Bravo site is not considered to be a likely event.

From consultation with the UK shipping industry it is assumed that merchant ships will normally not attempt to navigate between wind farm structures due to the restricted sea room and will be directed by the navigational aids in the area.

Based on modelling the revised vessel routes which are estimated to be used with the Project Bravo structures in place and using local metocean data, the frequency of a passing powered vessel collision was estimated to be 4.40×10^{-4} per year (approximately 1 every 2,272 years). This collision frequency is lower than the historical average of 5.3×10^{-4} per installation-year for offshore installations on the UKCS (1 every 1,900 years).

The individual collision frequencies ranged from 1.98×10^{-4} for the collector station in the south east corner of the Project Bravo site to 0 for a WTG within the centre of the wind farm. A plot showing the passing powered collision frequency for each structure within Project Bravo is presented in Figure 15.4.

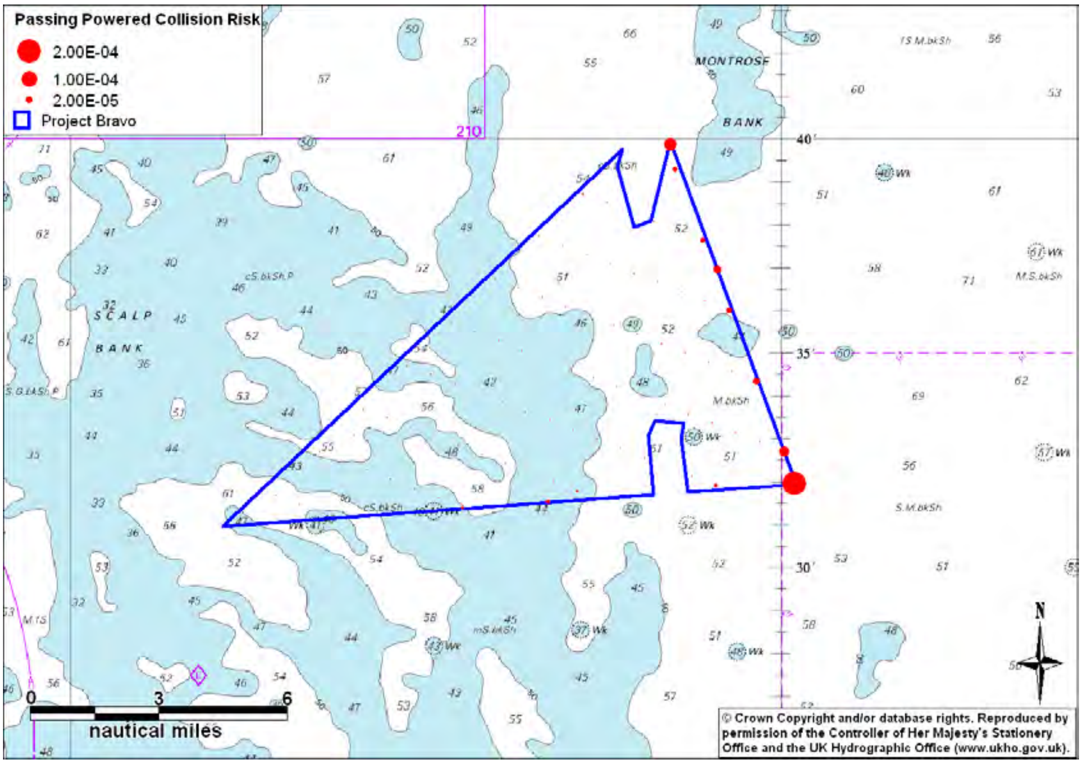

Figure 15.4 Annual Passing Powered Collision Frequency

Drifting Vessel Collision

The risk of a vessel losing power and drifting into the proposed Project Bravo structures was assessed using Anatec's COLLRISK model. This model is based on the premise that propulsion on a vessel must fail before a vessel will drift. The model takes account of the type and size of the vessel, number of engines and average time to repair in different conditions.

The exposure times for a drifting scenario are based on the ship-hours spent in proximity to the Project Bravo site (up to 10nm from perimeter). These have been estimated based on the traffic levels, speeds and revised routeing pattern. The exposure is divided by vessel type and size to ensure these factors, which based on analysis of historical accident data have been shown to influence accident rates, are taken into account within the modelling.

Using this information the overall rate of breakdown within the area surrounding the wind farm was estimated. The probability of a ship drifting towards a structure and the drift speed are dependent on the prevailing wind, wave and tide conditions at the time of the accident.

The following drift scenarios were modelled:

- Wind;
- Peak Spring Flood Tide; and
- Peak Spring Ebb Tide.

The probability of vessel recovery from drift is estimated based on the speed of drift and hence the time available before reaching the wind farm structure. Vessels that do not recover within this time are assumed to collide.

After running the drifting model for Project Bravo, it was established that flood tide-dominated drift produced the worst case results.

The worst case annual drifting vessel collision frequency for Project Bravo was estimated to be 4.26×10^{-5} per year corresponding to an average of one drifting vessel collision every 23,498 years. Drifting collisions are therefore assessed to be less frequent than powered collisions, which is reflective of historical data. There have been no reported 'passing' drifting ('Not under Command') vessel collisions with offshore installations on the UKCS in over 6,000 operational-years. Whilst a large number of drifting ships have occurred each year in UK waters, most vessels have been recovered in time, e.g., anchored, restarted engines or taken in tow. There have also been a small number of 'near-misses'.

The majority of the drifting vessel collision frequency is associated with the structures in the north easterly corner of the site and along the eastern boundary since the currents in the area run in a generally north east to south west direction on the flood.

15.3.3 Fishing Vessel Collision

Anatec's fishing vessel collision risk model (COLLRISK) has been calibrated using fishing vessel activity data along with offshore installation operating experience in the UK (oil and gas) and the experience of collisions between fishing vessels and UKCS offshore installations (published by HSE).

The two main inputs to the model are the fishing vessel density for the area and the structure details. The fishing vessel density in the Project Bravo site was based on fishing vessel sightings data (2005-2009).

Using the above site-specific data as input to the model, the annual fishing vessel collision frequency for Project Bravo was assessed to be 1.04×10^{-2}, which corresponds to an average of one collision every 96 years.

It should be noted that this value assumes the fishing vessel density following the development will remain the same as current levels. However, there is uncertainty in this assumption as a proportion of fishing vessels may avoid the site whilst others may be attracted to the site due to the potential fish aggregating characteristics of the wind farm structures and their scour material.

It is also noted that this frequency includes for all types of impacts with wind farm structures many of which may be minor due to the slow speeds involved whilst fishing.

15.3.4 Recreational Vessel Collision

There are two main collision hazards from recreational vessels interacting with wind farms:

1. WTG Rotor Blade to Yacht Mast Collision; and
2. Vessel Collision with Main Structures

Details of the recreational vessel collision hazards for Project Bravo is the same as presented in Section 14.3.4 for Project Alpha.

15.4 *Cable Interaction*

Details of interaction between vessels and array cables for Project Bravo is the same as presented in Section 14.4 for Project Alpha.

15.5 *Future Case Level of Risk*

15.5.1 Shipping

The assessment of the future case level of shipping for Project Bravo is the same as presented in Section 14.5.1 for Project Alpha.

15.5.2 Fishing

The assessment of the future case level of fishing for Project Bravo is the same as presented in Section 14.5.2 for Project Alpha.

15.5.3 Recreational

The assessment of the future case level of recreational vessels for Project Bravo is the same as presented in Section 14.5.3 for Project Alpha.

15.5.4 Collision Probabilities

The assessment of the future case collision probabilities for Project Bravo is the same as presented in Section 14.5.4 for Project Alpha.

15.6 *Risk Results Summary*

The base case and future case annual levels of risk without and with the Project Bravo proposal are summarised in Table 15.1. The change in risk is also shown, i.e., the estimated collision risk with the wind farm minus the estimated baseline collision risk without the wind farm (which is zero except for vessel-to-vessel collisions).

Table 15.1 Summary of results – Project Bravo

Collision Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	4.40E-04	4.40E-04	--	4.84E-04	4.84E-04
Passing Drifting	--	4.26E-05	4.26E-05	--	4.69E-05	4.69E-05
Vessel-to-Vessel	3.23E-04	6.41E-04	3.18E-04	3.55E-04	7.05E-04	3.50E-04
Fishing	--	1.04E-02	1.04E-02	--	1.14E-02	1.14E-02
Total	3.23E-04	1.15E-02	1.12E-02	3.55E-04	1.27E-02	1.23E-02

The overall annual level of collision risk is estimated to increase due to the proposed development by approximately 1 in 89 years (base case) and 1 in 81 years (future case). The majority of this risk is from fishing vessel collisions.

15.7 *Consequences*

The probable outcomes for the majority of hazards are expected to be minor. However, the worst case outcomes could be severe, including events with potentially multiple fatalities.

A collision involving a larger ship is likely to result in collapse of a WTG with limited damage to the ship. Breach of a ship's fuel tank is considered unlikely and in the case of vessels carrying hazardous cargoes, e.g., tanker or gas carrier, the additional safety features associated with these vessels would further mitigate the risk of pollution (for example double hulls). Similarly, in a drifting collision the proposed wind farm structures are likely to absorb the majority of the impact energy, with some energy also being retained by the vessel in terms of rotational movement (glancing blow).

In terms of smaller vessels such as fishing and recreational craft, the worst case scenario would be risk of vessel damage leading to foundering of the vessel and potential loss of life.

A quantitative assessment of the potential consequences of collision due to the proposed wind farm is presented in Appendix G This applies the site-specific collision frequency results presented above with estimated outcomes in terms of fatalities on-board and oil pollution from the vessel based on research into historical collision incidents (MAIB, ITOPF, etc.).

The annual increase in PLL due to the impact of Project Bravo is estimated to be as follows:

- Base Case PLL: 3.62E-04 fatalities per year; and
- Future Case PLL: 3.99E-04 fatalities per year

The overall increase in PLL estimated due to the development is 3.62×10^{-4} fatalities per year (base case), which equates to one additional fatality in 2,759 years. This is a small change compared to the MAIB statistics which indicate an average of 29 fatalities per year in UK territorial waters.

In terms of individual risk to people, the incremental increase for commercial ships (in the region of 10^{-9}) is very low compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

Similarly, for fishing vessels, whilst the change in individual risk attributed to the development is higher than for commercial vessels (in the region of 10^{-6}), it is relatively low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

Therefore, the incremental increase in risk to both people and the environment caused by the Project Bravo is estimated to be low.

16. CONSTRUCTION AND DECOMMISSIONING EFFECTS

16.1 *Introduction*

This study has primarily focused on the operational and maintenance stage of the Phase 1 wind farms and transmission asset development, however, it is recognised that there will be additional potential effects during the construction and decommissioning stages of the projects.

In general, whilst the same hazards apply as during operational and maintenance, there are additional hazards which are distinctly associated with these stages of the projects and require different risk control measures.

16.2 *Hazards during Construction/Decommissioning*

During the construction/decommissioning stage there will be an increased level of vessel activity within the Phase 1 wind farm sites and along the ECR corridor.

The presence of construction/cable installation vessels within the area is likely to pose an additional navigational risk, although such vessels can also provide on-site response and mitigation. The main hazards associated with construction/decommissioning which have been identified over and above those associated with all stages of development (i.e., where the same risk control measures and emergency response will apply during all stages) are listed below.

- Construction/cable installation vessel collision with another vessel on-site;
- Construction/cable installation vessel collision with structure;
- Construction/cable installation vessel collision with passing vessel en route to or from site;
- Construction/cable installation vessel encounters (jack-ups or anchors on) underwater obstruction (e.g., cable, pipeline etc.);
- Construction/cable installation vessel jacks-up or anchors onto unexploded ordnance;
- Man overboard during personnel transfer operations; and
- Dropped object during major lifting operations.

It is noted that, to a large extent, the hazards will depend on the vessels and procedures which are to be used for these operations. This will not be known in detail until the structures, construction methods and vessels/contractors have been selected. It is therefore planned that hazard/risk assessment workshops be carried out as part of the project-planning process. The objective of the workshops will be to identify all of the different activities which will be taking place and identify any potential hazards as well as appropriate mitigation measures and operating procedures relevant to the selected vessels and construction methods.

An example measure might be that, wherever possible, construction vessels would follow prescribed transit corridors. These corridors would be defined in consultation with local maritime stakeholders, such as Aberdeen Harbour and Forth Ports.

The suggested compositions for the workshops are as follows:

- Project Team;
- Contractor Representatives (e.g., barges, cable-laying);
- Harbour Representatives;
- HM Coastguard (MCA);
- Fishing Representative;
- Recreational Vessel Representative; and
- RNLI Representative.

This process will build mutual understanding of the activities and operating constraints of the different parties involved and allow effective procedures to be developed. Separate workshops should be held for each stage of the projects as well as for distinct activities.

It is noted that the construction company appointed will have their own internal health and safety procedures that they will adhere to during the work, providing additional security. Experience and lessons learned from the construction of other offshore wind farm projects will be considered prior to the Phase 1 wind farms and export cables being constructed. The same process will apply during the decommissioning stage of the projects.

16.3 *Risk Control/Mitigation during Construction/Decommissioning*

Details of risk control/mitigation measures which will apply during these stages of the work are summarised in Section 22.

17. EFFECT ON MARINE RADAR SYSTEMS

17.1 *Radar Trials*

In 2004 the MCA conducted trials at the North Hoyle offshore wind farm off North Wales to determine any effect of WTGs on marine communications and navigations systems (Ref. v).

The trials indicated that there is minimal impact on VHF radio, GPS receivers, cellular telephones and AIS. Ultra High Frequency (UHF) and other microwave systems suffered from the normal masking effect when WTGs were in the line of the transmissions.

This trial identified areas of concern with regard to the potential impact on ship borne and shore based radar systems. This is due to the large vertical extent of the WTG generators returning radar responses strong enough to produce interfering side lobe, multiple and reflected echoes (ghosts). This has also been raised as a major concern by the maritime industry with further evidence of the problems being identified by the Port of London Authority (PLA) around the Kentish Flats offshore wind farm in the Thames Estuary. Based on the results of the North Hoyle trial, the MCA produced a wind farm/shipping route template (see Section 2.3) to give guidance on the distances which should be established between shipping routes and offshore wind farms.

A second trial was conducted at Kentish Flats between 30 April 2006 and 27 June 2006 on behalf of British Wind Energy Association (BWEA) (Ref. vi). The project steering group had members from Department for Business Enterprise & Regulatory Reform (BERR), the MCA and the PLA. This trial was conducted in Pilotage waters and in an area covered by the PLA VTS. It therefore had the benefit of Pilot advice and experience but was also able to assess the impact of the generated effects on VTS radars.

The trial concluded that:

- The phenomena referred to above detected on marine radar displays in the vicinity of wind farms can be produced by other strong echoes close to the observing ship although not necessarily to the same extent;
- Reflections and distortions by ships structures and fittings created many of the effects and that the effects vary from ship to ship and radar to radar;
- VTS scanners static radars can be subject to similar phenomena as above if passing vessels provide a suitable reflecting surface but the effect did not seem to present a significant problem for the PLA VTS; and
- Small vessels operating in or near the wind farm were detectable by radar on ships operating near the array but were less detectable when the ship was operating within the array.

17.2 *Beatrice Demonstrator WTG Project Radar Impacts Study*

As well as the documented radar trials carried out at North Hoyle and Kentish Flats, a study was carried out on the impacts of the two 5 megawatt (MW) Demonstrator WTGs located in the Moray Firth east of the Beatrice Oil Field (Ref. xvi).

The main findings of this study are summarised below:

- Regarding the Beatrice platform radar - any fluctuations of the WTG plots, (caused by the motion of the WTGs) could lead to occasional false alarms in the collision avoidance systems;
- Ship based radar plots showed that the proposed WTGs do not make a significant detrimental impact on the overall radar picture. The returns from the WTGs are large enough to cause plots on a radars display (which can be used for navigation in the normal way);
- Obstruction issues - in the case of Beatrice, the WTG platform is based on a jacket structure, which allows the radar energy through the base of the WTG. In addition, the phenomenon of diffraction means that any shadow cast behind a WTG quickly fills back in;
- Furthermore, AIS is unlikely to be affected and the study indicated that shadowing by the WTGs will not cause any loss of AIS transponder signals; and
- Final conclusions were that there were no radar effect caused by the WTGs that are not already caused by other large structures such as oil platforms and large ships.

17.3 *Effect on Collision Risk*

The potential radar interference is mainly a problem during periods of bad visibility when mariners may not be able to visually confirm the presence of other vessels in the vicinity (i.e. those without AIS installed which are usually fishing and recreational craft).

Given that recreational vessel activity is influenced by weather conditions (and the fact that no recreational vessels were recorded in the *EEMS* winter survey), most yachts are likely to take more sheltered coastal routes and not pass through the Phase 1 wind farms. Therefore, fishing vessels are considered to be the most likely to be affected by possible radar interference.

Based on the trials carried out to date, the onset range from the WTGs of false returns is about 1.5nm, with progressive deterioration in the radar display as the range closes.

Figure 17.1 and Figure 17.2 present the combined 40 days of survey tracks relative to Project Alpha and Project Bravo respectively. 500m, 1.5nm and 2nm buffers have been applied around each WTG location to illustrate current passing distances.

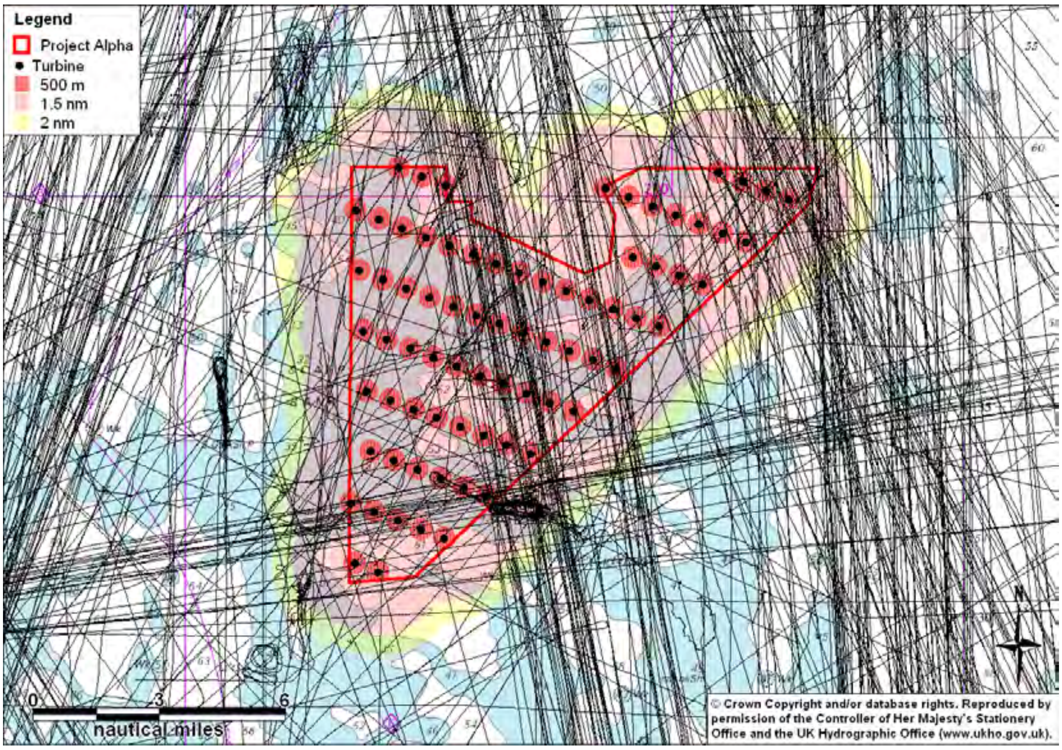

Figure 17.1 Project Alpha Wind Farm Site versus Current Marine Traffic Tracks (40 days)

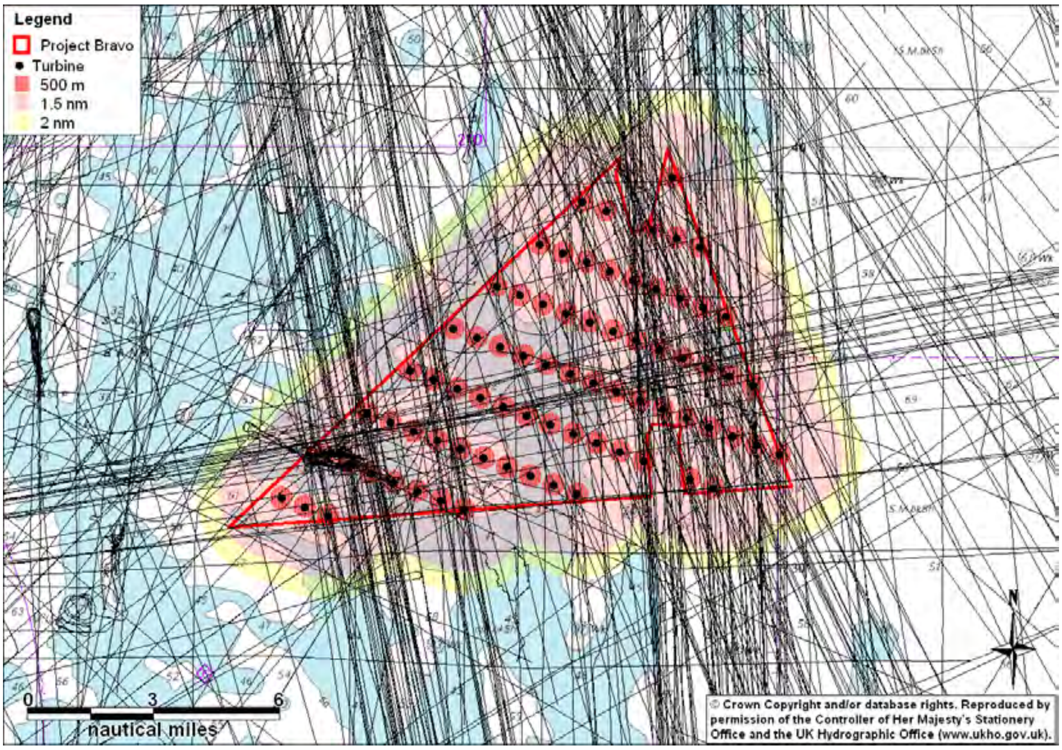

Figure 17.2 Project Bravo Wind Farm Site versus Current Marine Traffic Tracks (40 days)

It can be seen that, at present, a number of fishing vessels and commercial vessels passing through Project Alpha and Project Bravo in a north-south and east-west direction are inside the 1.5nm range from WTGs at which radar interference could be experienced.

It is noted that upon development of the proposed wind farms, commercial vessels are likely to pass 1 to 1.5nm from the wind farm boundaries, thereby subject to a small level of radar interference. However, there is sufficient sea room, especially to the east of the Project Bravo site for vessels to increase their clearance, should they consider it necessary.

Experienced mariners should be able to suppress the observed problems to an extent and for short periods (a few sweeps) by careful adjustment of the receiver amplification (gain), sea clutter and range settings of the radar. However, there is a consequential risk of losing targets with a small radar cross section, which may include buoys or small craft, particularly yachts or Glass Reinforced Plastic (GRP) constructed craft, therefore due care is needed in making such adjustments. The Kentish Flats study observed that the use of an easily identifiable reference target (a small buoy) can help the operator select the optimum radar settings.

The performance of a vessel's automatic radar plotting aid (ARPA) could also be affected when tracking targets in or near the wind farm. However, although greater vigilance is required, it appears that during the Kentish Flats trials, false targets were quickly identified as such by the mariners and then the equipment itself. This was also observed during work carried out for the Beatrice Demonstration WTGs whereby the structures were plotted and could be used as an aid to navigation.

The evidence from mariners operating in the vicinity of existing wind farms is that they quickly learn to work with and around the effects. The MCA have produced guidance to mariners operating in the vicinity of UK OREIs which highlights radar issue amongst others to be taken into account when planning and undertaking voyages in the vicinity of OREIs off the UK coast (Ref. xvii).

AIS information can also be used to verify the targets of larger vessels, generally ships above 300 tonnes, however small fishing and recreational craft are increasingly utilising the cheaper Class B AIS units.

In Directive 2009/17/EC of the European Parliament and of the council of April 23 2009 amended Directive 2002/59/EC (Ref. xviii), one of the main amendments made related to the use of AIS on fishing vessels, which is addressed through the insertion of Article 6a:

Use of Automatic Identification Systems (AIS) by fishing vessels.

Any fishing vessel with an overall length of more than 15 metres and flying the flag of a Member State and registered in the Community, or operating in the internal waters or territorial sea of a Member State, or landing its catch in the port of a Member State shall, in accordance with the timetable set out in Annex II, part I (3), be fitted with an AIS (Class A) which meets the performance standards drawn up by the IMO.

Fishing vessels equipped with AIS shall maintain it in operation at all times. In exceptional circumstances, AIS may be switched off where the master considers this necessary in the interest of the safety or security of his vessel.

The timetable set out in Annex II, part 1(3) is as follows:

Fishing vessels with a length of more than 15 metres overall are subject to the carrying requirement laid down in Article 6a according to the following timetable:

- fishing vessels of overall length 24 metres and upwards but less than 45 metres: not later than 31 May 2012,
- fishing vessels of overall length 18 metres and upwards but less than 24 metres: not later than 31 May 2013,
- fishing vessels of overall length exceeding 15 metres but less than 18 metres: not later than 31 May 2014.

New built fishing vessels of overall length exceeding 15 metres are subject to the carrying requirement laid down in Article 6a as from 30 November 2010.'

Beyond this, it is noted from a number of surveys Anatec has been carrying out on the UKCS that the number of fishing vessels using AIS has increased significantly over the last two years.

18. CUMULATIVE AND IN-COMBINATION EFFECTS

18.1 *Introduction*

This section presents details of the potential cumulative and in-combination effects associated with the development of the Phase 1 wind farms and transmission asset based on the following factors:

- Wind farm developments within the UK Renewable Energy Zone (REZ) and their ECRs (an area defined by the Energy Act 2004 (Ref. xx));
- Assessment of FTOWDG regional developments; and
- Assessment of in-combination effects of the Phase 1 wind farms and transmission asset projects with other (i.e. non-OREI) marine developments.

18.2 *Renewable Developments within the UK Renewable Energy Zone (REZ)*

Figure 18.1 presents all Round 1 and 2 offshore wind farms, Round 3 Zones and Scottish Territorial Water (STW) sites currently leased within the UK REZ. These projects are currently at different stages of consenting, construction or operation.

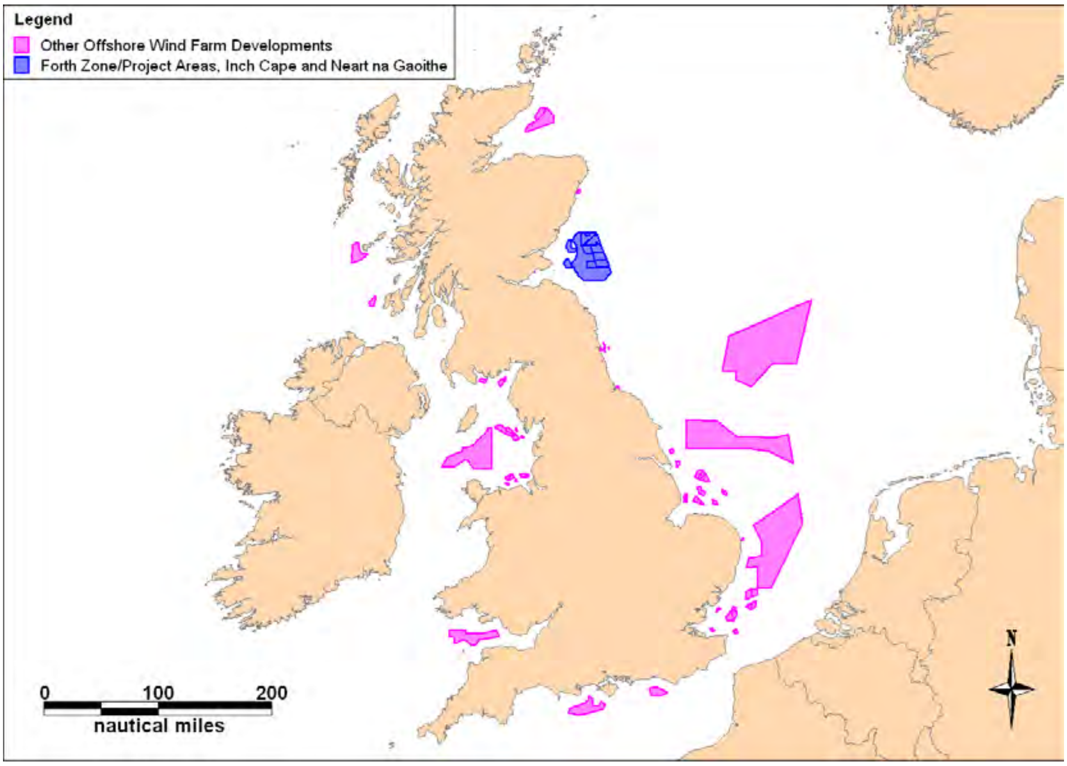

Figure 18.1 Overview of Wind Farm Sites in UK

It can be observed that Project Alpha and Project Bravo in the Zone are in close proximity to the Inch Cape and Neart na Gaoithe STW sites. These sites are located approximately 4.7nm and 14.8nm respectively from the western boundary of the Phase 1 wind farms. It is these three wind farm developments which comprise FTOWDG.

Outside of the outer Firth of Forth and Tay region there are no other wind farms in close proximity. The nearest wind farm development is the EOWDC located off the coast of Aberdeen (approximately 31nm to the north of Project Alpha and Project Bravo). In terms of the EOWDC, no cumulative issues are expected along the north east coastline of Scotland.

18.3 *Assessment of Project Boundaries*

Figure 18.2 presents the zone, project and site boundaries which are being used for the cumulative assessment.

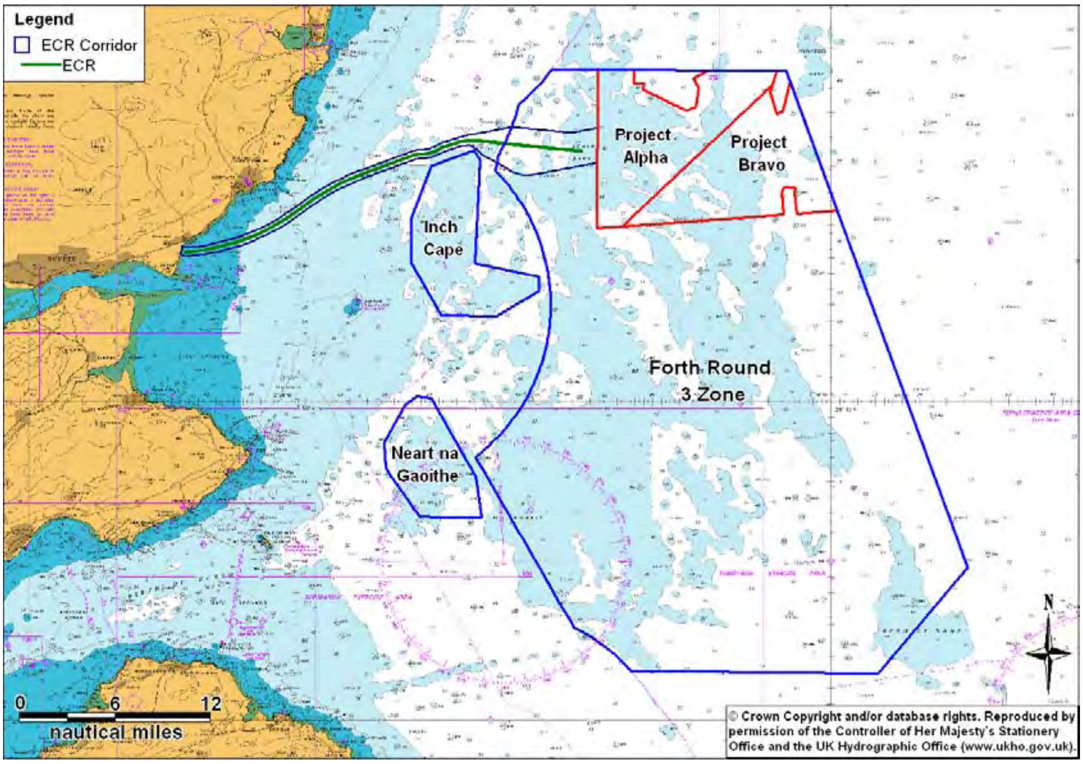

Figure 18.2 Boundaries used for Cumulative Assessment

For the cumulative assessment, it is assumed that the Phase 1 wind farms (Project Alpha and Project Bravo), Neart na Gaoithe and Inch Cape will be filled to full site capacity. A variation of the 'full capacity' layout for the Phase 1 wind farms will also be considered which does not contain any wind farm structures along the boundary between the Project Alpha and Project Bravo sites (see Section 3.4).

It was agreed with Marine Scotland that a detailed analysis of Phases 2 and 3 will not be included in the cumulative assessment at this stage given the data gaps, further work required and the magnitude of the design assumptions.

The following sections firstly assess the potential cumulative effects of the Seagreen Project (Project Alpha, Project Bravo and Transmission Asset Project) and then consider the Seagreen Project with other existing, consented or proposed developments and activities in the Firth of Forth region and beyond.

The assessment assumes industry standard mitigation measures (as per MGN 371 and IALA O-139); see Section 22.

18.4 *Cumulative Effects of Project Alpha, Project Bravo and Transmission Asset Project*

18.4.1 Commercial Ship Routeing and Collision Risk

Figure 8.32 presented eight main routes which were identified as intersecting Project Alpha and Project Bravo. Of these eight routes, seven will be impacted by Project Alpha in isolation and seven will be impacted by Project Bravo in isolation. The combined presence of Project Alpha and Project Bravo will impact all eight of the main routes and require vessels to deviate in order to achieve a safe passing distance from the structures.

Three of the main routes were identified as being used by more than 1 vessel per day and their potential deviations were calculated as presented in Sections 9 and 10. The impact on these routes from the combined presence of Project Alpha and Project Bravo is described below.

Route 1 between Aberdeen and Humber is mainly used by tankers (70%) with a small number of cargo vessels also being recorded during the maritime traffic surveys. Vessels on this route are expected to route to the east of the wind farm if Project Alpha is built in isolation and to the west if Project Bravo is built in isolation. With both projects built, vessels could route either way depending on weather conditions and individual preferences. This is not expected to have a significant effect on navigational risk.

Route 2 between Aberdeen and Humber/European ports is used by cargo vessels (57%) and tankers (24%). If either Project Alpha or Project Bravo were built in isolation then it would be expected that vessels would route to the east of the wind farm to achieve a safe passing distance. Therefore, the vessels on this route will not be cumulatively impacted by the joint presence of Project Alpha and Project Bravo. However, given that vessels on Route 1 are expected to take a similar route, the traffic density will be increased which could increase the risk of encounters and therefore collisions.

Route 3 between Northern Scottish ports and Humber does not pass through Project Alpha. Therefore, vessels on this route will not be cumulatively affected by the combined presence of Project Alpha and Project Bravo.

If the Project Alpha and Project Bravo sites were not filled to full site capacity and a gap was created between them (see Figure 3.7) then some vessels from Firth of Forth Ports to

Northern Europe may choose to transit through the gap in order to reduce their passage time and avoid deviating around Project Alpha and Project Bravo. Given that the width of the gap is approximately 1.5nm, this will significantly increase the risk of collisions for vessels on this route. There will also be an increased collision risk between commercial vessels on the route and fishing vessels/recreational vessels exiting the wind farm and crossing the gap.

18.4.2 Recreation Vessels

Two RYA 'medium-use' cruising routes were identified as intersecting the Phase 1 wind farms (Figure 11.2). Both of these routes intersect Project Alpha and one of the routes intersects Project Bravo. Therefore, the combined presence of Project Alpha, Project Bravo and the Transmission Asset Project will influence both of the cruising routes.

There is the potential for an increased vessel to structure collision risk because recreational vessels passing through the Project Alpha and Project Bravo Sites will spend a longer amount of time surrounded by wind farm components and infrastructure when Project Alpha, Project Bravo and the Transmission Asset Project are all built, when compared to one being built in isolation.

There will also be an increased number of displaced commercial vessels that recreational vessels could collide with.

A notable hazard for recreation vessels will be if the 1.5nm gap is created along the boundary between Project Alpha and Project Bravo (Figure 3.7) and used by commercial vessels as this will create an additional collision risk to recreational vessels exiting Project Alpha or Project Bravo into this gap.

18.4.3 Fishing Vessels

Fishing vessels transiting through the Project Alpha and Project Bravo sites to/from fishing grounds will spend a longer amount of time surrounded by wind farm components and infrastructure when Project Alpha, Project Bravo and the Transmission Asset Project are all built, when compared to one being built in isolation. This is expected to increase the fishing vessel to structure collision risk.

There will also be an increased number of subsea cables which can be potential snagging hazards for fishing vessels operating in the area and an increased number of displaced commercial vessels that fishing vessels could collide with.

As was described above for recreational vessels, the collision risk to fishing vessels exiting the wind farm is likely to increase if the 1.5nm gap is created along the boundary between Project Alpha and Project Bravo and used by commercial vessels.

18.5 *Cumulative effects of Phase 1, Inch Cape, Neart na Gaoithe and Other Schemes*

The following section assesses the potential cumulative and in-combination effects associated with the Phase 1 wind farms, Inch Cape, Neart na Gaoithe and other schemes.

18.5.1 Commercial Ship Routeing and Collision Risk

Due to the combined presence of the Seagreen Project and Inch Cape, vessels which would have otherwise been deviated to the west of the Seagreen Project are likely to be deviated to the east to avoid transiting through the gap between Project Alpha and Inch Cape (approximately 4.7nm at the narrowest point). This will increase the vessels numbers and traffic density in the area to the east of the Seagreen Project, thus increasing the risk of encounters and collisions.

Vessels transiting from Firth of Tay Ports (Dundee and Perth) to offshore platforms and Scandinavian ports (Gdansk, Copenhagen and Gothenburg) currently pass through the south of Project Alpha and Project Bravo in an east-west direction. Vessels on this route will be cumulatively affected by the presence of Inch Cape, meaning they are likely to alter their course to the south when leaving the River Tay ports and pass between Inch Cape and Neart na Gaoithe (the distance between the two sites is approximately 5.3nm) and then into the Firth of Forth zone. Alternatively, they may choose to deviate to the north of Project Alpha and Project Bravo.

There will be an increase in the vessel to structure collision risk due to the increased number of structures when multiple offshore wind farms are present.

Greater deviations may be required during overlapping construction and decommissioning stages of the different projects within the region whilst rolling safety zones are in place, therefore increasing the risk to vessels. However, these activities are generally of short duration and limited extent.

There are no oil and gas installations within the Project Alpha or Project Bravo sites (with the nearest being the Curlew FPSO approximately 96nm east of the Project Alpha and 95nm east of Project Bravo). Therefore, offshore operations themselves are not expected to be directly affected following the construction of the Project Alpha and Project Bravo wind farms. However, support and supply vessels transiting from Firth of Forth ports and Firth of Tay ports to offshore installations may be deviated by the presence of the wind farms, thus increasing their routeing distance. Furthermore, jack-up drilling rigs being towed to Dundee for maintenance are likely to keep well clear of the sites, thus increasing the distance over which they are towed.

There are currently proposals in place for three biomass plants at port locations within the Firth of Forth and Tay region (located at Dundee, Grangemouth and Rosyth). The Environmental Statements (ES) for the proposed sites state that the majority of fuel will be delivered to the plants by vessels which will increase the number of vessels in port approaches. However, at the time of writing this NRA (July 2012) it is not known where vessels will be routeing from so further consideration of the potential in-combination effects is not possible.

The major ports in the vicinity of the Phase 1 wind farms are located within the Firths of Forth and Tay areas; therefore in-combinations effects on vessels are likely to be linked to associated traffic movements rather than port functions (pilots generally board within the inner Firth of Forth). Following a review of the future case traffic (Section 14.5), potential increases in traffic associated with new or improved port developments is likely to have a small effect on the Project Alpha and Project Bravo developments.

18.5.2 Recreation Vessels

Based on the analysis of recreational vessel data collected during the maritime traffic surveys, it was identified that the majority of recreational vessels intersecting the Project Alpha and Project Bravo sites were headed in a north-south direction. They are expected to continue to pass through the Project Alpha and Project Bravo sites when the structures are in place which means that the presence of Inch Cape and Neart na Gaoithe is not expected to further impact their routes

There will be an increased number of displaced commercial vessels that recreational vessels can collide with due to the combined presence of the Seagreen project and other schemes displacing large number of commercial vessels into reduced sea areas. It is anticipated that recreational vessels displaced into commercial vessel routes or exiting the Project Alpha and Project Bravo Sites into commercial vessel routes will encounter a greater number of vessels, therefore increasing the collision risk.

The recreational vessel to structure collision risk is also expected to increase given the larger number of structures that are in place when multiple wind farms are considered.

18.5.3 Fishing Vessels

Based on the analysis of fishing vessel data collected during the maritime traffic surveys, it was identified that the majority of fishing vessels transiting through the Project Alpha and Project Bravo sites were headed in a north-south direction. This means that the presence of Inch Cape and Neart na Gaoithe is not expected to further impact their routes.

When multiple offshore wind farms are present there will be an increased number of array cables which can be potential snagging hazards for fishing vessels operating in the area.

There will also be an increased number of displaced commercial vessels that fishing vessels can collide with due to the combined presence of the Seagreen project and other schemes displacing commercial vessels into reduced sea areas. It is anticipated that fishing vessels displaced into commercial vessel routes or exiting the Project Alpha and Project Bravo Sites into commercial vessel routes will encounter a greater number of vessels, therefore increasing the collision risk.

The fishing vessel to structure collision risk is also expected to increase given the larger number of structures that are in place when multiple wind farms are considered.

18.5.4 Emergency Response

Due to the higher volume of traffic associated with the wind farm developments (construction, maintenance and decommissioning vessels) and the increased risk of vessel to vessel collisions on displaced routes due to the presence of multiple wind farms, there is likely to be an increase in the demand for emergency response from the current baseline level. The presence of the structures within wind farms could potentially aid emergency response efforts by providing a point of reference and a temporary place of refuge for casualties awaiting rescue.

19. Safety Zones

19.1 *Guidance on Applications for Safety Zones*

Guidance for safety zone applications can be found in the DECC guidance notes (authored whilst under the name of BERR (Ref. xix). The safety zone scheme, as set out in the Energy Act 2004 (Ref. xx) applies to territorial waters in or adjacent to England, Scotland and Wales. A safety zone can be established either by the successful application by an applicant or, if no such application is made and the view of the Secretary of State for DECC, following consultation with the MCA Navigation Safety Branch, is that a safety zone is necessary, by the Secretary of State.

Where a consent for an OREI is required from the Secretary of State under Section 36 of the Electricity Act 1989 (Ref. xxi) the Secretary of State must consider whether a safety zone will be needed at the same time that consideration is given to the consent for the OREI development. The safety zone application process is summarised below:

- The applicant makes an application to the Secretary of State and serves notice of application on the MCA and, as appropriate, the Scottish Government or National Assembly for Wales, providing information as necessary to support the case for the safety zone;
- In parallel the applicant publicises the fact that an application is being made to give an opportunity to anyone who wishes to comment on the application to make their views known to the Secretary of State; and
- The Secretary of State then takes a decision on the application, taking into account any comments they have received and all other material considerations.

19.2 *Construction/Decommissioning & Major Maintenance Stages*

During the construction/decommissioning stages of the Phase 1 developments, and during times of major maintenance, there will be large construction vessels, working personnel and support craft in operation within and around the Phase 1 wind farms and ECR corridor. Further heavy lifting, piling and cable laying operations will be carried out which have inherent dangers.

In addition to the cost of operating construction vessels, the cost of delays to construction can be significant. A means of controlling third party navigation during these periods of high activity is required. Without this, it will not be possible to exclude vessels and carry out their offshore operations in a controlled manner.

Section 95 of the Energy Act 2004 (Ref. xx) introduced provisions to provide for the establishment of safety zones around OREIs to ensure the safety of the wind farm infrastructure, individuals working thereon, construction vessels and other vessels navigating in the area whilst works take place.

Section 95(5) confirms that an area may be declared to be a safety zone only if it is an area of waters around or adjacent to a place where an OREI is to be, or is being, constructed, extended, operated or decommissioned; but may also extend to waters outside the waters subject to regulation under Section 95. In the case of OREIs safety zones, 'rolling' safety zones around wind farm infrastructure and construction vessels, of 500m can be applied for during construction and decommissioning.

It is proposed that 'rolling' safety zones around construction vessels will be applied for during construction in accordance with the definition of 'construction' provided at Section 104(1) Energy Act 2004 (Ref. xx) which includes the installation of electric lines. It is intended to make applications for the establishment of safety zones to DECC for the Transmission Asset Project as well as for Project Alpha and Project Bravo to cover the construction stage of the projects. This will provide a means of regulating the rights of navigation so as to preserve the safety of those working in the wind farms and those onboard other vessels that may be navigating in this area. These safety zones will apply to all vessel types not involved in the wind farm operations.

During the construction and decommissioning stages, operational procedures will be implemented for VHF, radar and AIS monitoring of vessel activities within the working area, to detect safety zone infringements. Procedures will also be established to ensure that any infringements are formally reported in line with the regulatory requirements.

Occasionally larger support vessels may be required for planned and unplanned maintenance activities. It is likely that several pre-determined areas would be identified and marked. In these cases, semi-permanent structure markings would also comply with the NLB requirements and IALA O-139 and 500m safety zones would apply.

19.3 *Operational Phase*

During normal operations the working activities will be limited to general and emergency maintenance work and as such the benefits and requirements for safety zones were reassessed giving account to the working vessels likely to be present within and around the wind farms. These vessels will generally be smaller than those involved in the construction stages of the project, therefore safety zones are not considered necessary during normal operation.

In terms of third-party vessels, it is considered highly unlikely that merchant ships would elect to pass between wind farm structures due to the limited sea room and the fact that the closest routes tend to naturally avoid the location. Therefore, it is only fishing and recreational vessels which may choose to pass between wind farm structures.

It will be up to individual Masters, taking into account the prevailing weather and sea conditions, to decide whether it is safe to navigate, or fish, within the WTG array.

It is intended to make applications for the establishment of operational safety zones, of up to a maximum of 50m around each wind farm structures from their outer edge, for Project

Alpha and Project Bravo to DECC once the final number and precise location of the wind farm structures (including OSPs and meteorological masts) has been determined.

19.4 *Summary*

The expected safety zones are as follows:

- Construction/Decommissioning and Major Maintenance:
    - 500m rolling safety zones to prevent vessels not associated with the development work from interfering with the active construction site.
- Operation:
    - 50m operational safety zones to prevent vessels not associated with the development work from interfering with the wind farm structures.

The existence of safety zones will be published electronically and via Notices to Mariners.

20. Emergency Response

20.1 *Introduction*

This section summarises the existing emergency response resources in the region and the issues being considered in relation to the design of the proposed wind farms.

(A detailed review of the historical incidents in the area, including RNLI launches, has been presented in Section 7.)

20.2 *Emergency Response Resources*

20.2.1 SAR Helicopters

A review of the SAR helicopter bases in the vicinity of Project Alpha and Project Bravo (Figure 20.1) indicated that the closest SAR helicopter bases are located at Boulmer and Lossiemouth, both of which are operated by the Royal Air Force (RAF). Due to the fact that RAF Boulmer is scheduled to close in 2015, the following section will describe the facilities available at RAF Lossiemouth. RAF Lossiemouth is situated approximately 157nm north-west of the proposed Project Alpha and Project Bravo sites. This base has Sea King helicopters with a maximum endurance of 6 hours and speed of 110 miles per hour (mph) giving a radius of action of approximately 250nm which is well within the range of the wind farm sites in Phase 1. One helicopter is available at 15 minutes readiness between 0800 and 2200 hours. Between 2200 and 0800 hours, one helicopter is held at 45 minutes readiness.

All RAF SAR helicopters are equipped for full day/night all weather operations over land and sea (some limitations exist with regard to freezing conditions, but, in general terms, the helicopters are all weather capable) and have a full night vision goggle (NVG) capability. Crews are well practised in NVG operations which is a major enhancement to SAR capability. In addition, all RAF SAR helicopter rear crew are medically trained, with the winchman trained up to paramedic standard.

Up to 18 persons can be carried, however this is dependent on weather conditions and the distance of the incident from the helicopter’s operating base. All RAF SAR helicopters are equipped with VHF (Marine and Air Band), UHF and High Frequency (HF) radios. They are also capable of homing to all international distress frequencies.

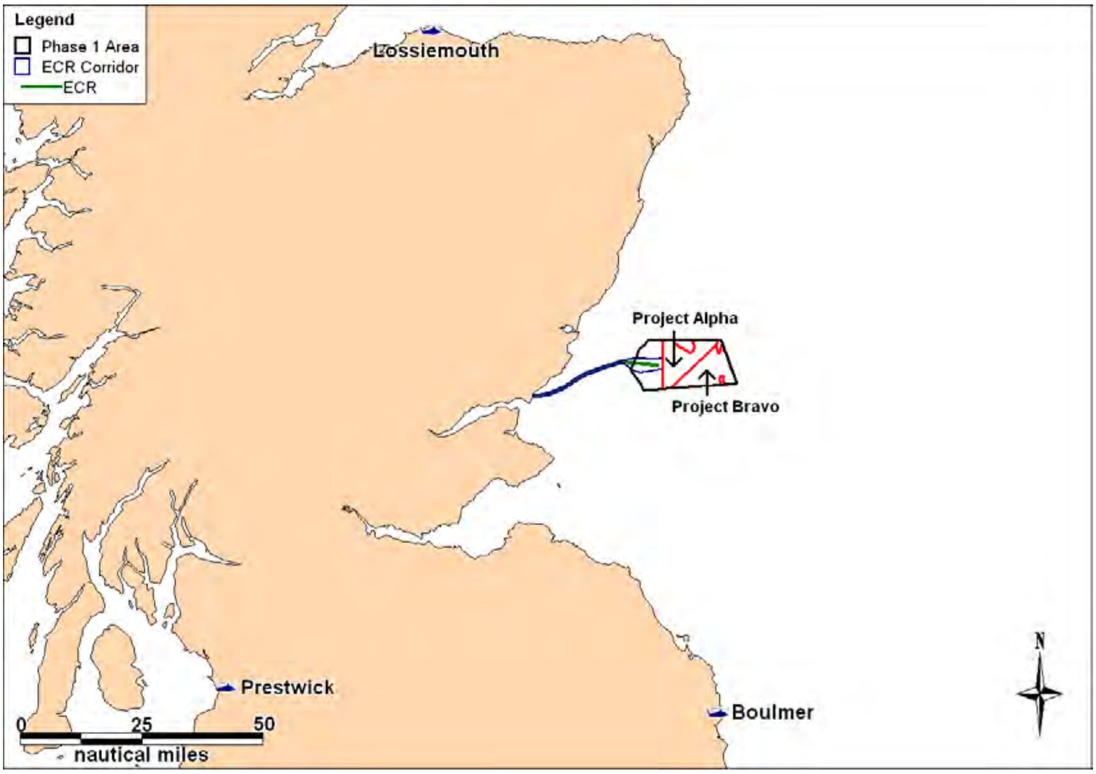

Figure 20.1 SAR Helicopter Bases relative to Project Alpha and Project Bravo

Based on the above information, the day-time response to the centre of Project Alpha will be approximately 1 hour and 7 minutes and the day-time response to the centre of Project Bravo will be approximately 1 hour and 10 minutes. At night time this will increase by 30 minutes to approximately 1 hour and 37 minutes to the centre of Project Alpha and 1 hour and 40 minutes to the centre of Project Bravo due to the additional response time at the base. It is noted that these calculation are based on still air and will vary depending on the prevailing conditions.

20.2.2 RNLI Lifeboats

The RNLI maintains an active fleet of over 300 lifeboats (of various types ranging from 5m to 17m in length) and a relief fleet of around 100 boats at 235 stations round the coast of the UK and Ireland.

The RNLI stations in the vicinity of the proposed wind farms (Project Alpha and Project Bravo) are presented in Figure 20.2.

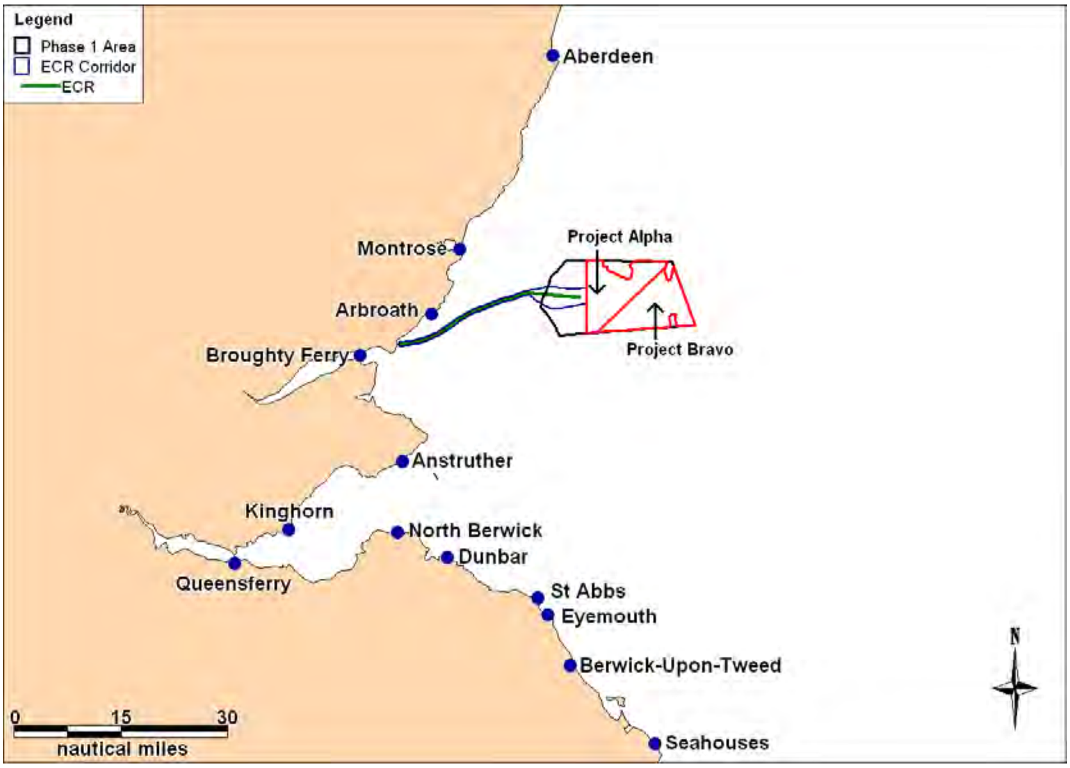

Figure 20.2 RNLI Bases near Project Alpha and Project Bravo

At each of these stations, crew and lifeboats are available on a 24-hour basis throughout the year. Table 20.1 provides a summary of the facilities at the stations closest to the Project Alpha and Project Bravo sites within Phase 1.

Table 20.1 Lifeboats held at nearby RNLI stations

Station	Lifeboats	ALB Spec	ILB Spec	Distance to Centre of Project Alpha	Distance to Centre of Project Bravo
Aberdeen	ALB & ILB	Severn	D Class	33nm	36nm
Montrose	ALB & ILB	Tyne	D Class	22nm	28nm
Arbroath	ALB & ILB	Mersey	D Class	25nm	31nm
Broughty Ferry	ALB & ILB	Trent	D Class	36nm	41nm
Anstruther	ALB & ILB	Mersey	D Class	37nm	41nm

Based on the offshore position of the wind farm developments it is likely that ALBs from Montrose or Arbroath would respond to an incident within Project Alpha and Project Bravo. This is confirmed when reviewing the historical incident data (see Section 7.3).

All of the RNLI's all-weather lifeboats are inherently self-righting and fitted with the latest in navigation, location and communication equipment, including electronic chart plotter, VHF radio with direction finder, radar and GPS. Details of the ALB classes found at stations in the vicinity of Phase 1 are provided in the list below:

- The Severn class lifeboat is 17m in length, has a maximum speed of 25 knots and a 250nm range;
- The Tyne class lifeboat is 14m in length, has a maximum speed of 17 knots and a 240nm range;
- The Mersey class lifeboat is 12m in length, has a maximum speed of 17 knots and a 140nm; and
- The Trent class lifeboat is 14m in length, has a maximum speed of 25 knots and a 250nmrange.

D class lifeboats are small and highly manoeuvrable, making them ideal for rescues close to shore in fair to moderate conditions. D Class lifeboats are 5m in length, have a maximum speed of 25 knots and have a range of 3 hours at maximum speed. They are equipped with VHF radio and GPS and can be righted manually by their crew who are fully trained in manual capsize procedures.

Response times vary but an average declared by RNLI is 14 minutes for all-weather lifeboats and 7 minutes for inshore lifeboats. This is the time from callout, i.e., first contact from the Coastguard to the lifeboat station, to launch of the lifeboat.

The time for an all-weather lifeboat to reach the centre of Project Alpha (taking into account a 14 minute call out time) from the nearest station at Montrose would be approximately 1 hour and 31minutes. The time for an all-weather lifeboat to reach the centre of Project Bravo (taking into account a 14 minute call out time) from the nearest station at Montrose would be approximately 1 hour and 53 minutes.

20.2.3 Changes to Coastguard Stations

The MCA published a consultation document in December 2010 (Ref. xxii) in order to modernise HM Coastguard. The main part of the document proposes the reduction in the number of Maritime Rescue Co-ordination (MRCC) stations around the UK coastline.

Revised plans were released by the UK Government mid-way through 2011 (Ref. xxiii) with a second consultation period from 14 July 2011 to 6 October 2011. Under the revised proposals the MCA intends to:

- Establish a single 24 hour Maritime Operations Centre (MOC) based in the Southampton/Portsmouth area with 96 operational coastguards. The MOC will act as a national strategic centre to manage Coastguard operations across the entire UK network as well as co-ordinating incidents on a day to day basis. The MOC will also generate a maritime picture using information from a variety of sources;

- Dover will be configured to act as a stand-by MOC for contingency purposes. Dover would have 28 staff and would retain its responsibilities for the Channel Navigation Information Service (CNIS);

- In addition to the MOC and Dover, there will be eight further centres, (Maritime Rescue Sub-Centres (MRSCs)), all of which would be connected to the national network and the MOC. All would be open 24 hours a day with a total staffing of 23 in each. These would be based at the following stations:

  - MRSC Aberdeen;
  - MRSC Shetland;
  - MRSC Stornoway;
  - MRSC Belfast;
  - MRSC Holyhead;
  - MRSC Milford Haven;
  - MRSC Falmouth; and
  - MRSC Humber.

*The small station at London will be retained unchanged.

Note that at the time of writing, there is no further published information on the outcome of the consultation.

20.2.4 Effect of Changes to Coastguard Stations on the Proposed Sites

The proposed Phase 1 wind farms lie within the Scotland and Northern Ireland SAR region with the nearest rescue coordination centre located at MRCC Aberdeen. It is noted under the revised MCA SAR proposals, the Aberdeen centre will become a MRSC and it will respond to any incidents within the outer Firth of Forth including the incidents associated with the proposed wind farms.

20.2.5 Salvage

The MCA previously chartered four Emergency Towing Vessels (ETVs) to provide emergency towing cover in winter months in the four areas adjudged to pose the highest risk of a marine accident. The four ETV stations were at Dover, Falmouth, Shetland and Stornoway which had guard areas of the Dover Straits, South West Approaches, the Fair Isle Channel and the Minches respectively.

In 2010 it was announced that the ETV fleet would no longer be funded by the MCA from September 2011. The two Scottish ETVs operating in the Minches (*Anglian Monarch*) and the Fair Isle Channel (*Anglian Sovereign*) received an additional three month extended contract and during this time longer term arrangements were to be made to fund the ETVs. At the time of writing (May 2012), it has been proposed that the offshore supply vessel *Grampian Frontier* may replace the ETV *Anglian Sovereign* based at the ETV station in

Shetland. The ETV based at Stornoway (*Anglian Monarch*) was removed from duties in March 2012 with no alternative cover in place.

Each MRCC and MRSC holds comprehensive databases of harbour tugs available locally. Procedures are also in place with Brokers and Lloyd's Casualty Reporting Service to quickly obtain information on towing vessels that may be able to respond to an incident.

Emergency tug provision will generally be a contracted agreement between the vessel owners and tug operators. Coastguard Agreement on Salvage and Towage (CAST) will be invoked when owners are either unable or unwilling to engage in a commercial tow contract. MCA will pursue costs through arbitrators on a cost recovery basis.

There are various tugs in the vicinity of Project Alpha and Project Bravo. Briggs Marine and Environmental Services operate four tugs and two anchor handlers that work out of Burntisland, Fife. There are also tugs are on stand-by at the Hound Point / Braefoot Bay marine terminals. Finally, tug assistance may be available from offshore support vessels passing through the area.

20.3 *Wind Farm Emergency Response Matters*

Project Alpha and Project Bravo will meet the MCA's requirements in terms of standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around the site. These are laid out in Annex 5 of MGN 371 (Ref. i).

This includes the development of Emergency Response Co-operation Plans (ERCoPs) for the wind farms, which will be in place pre-construction.

Examples of features to be incorporated are as follows:

Design:

- All wind farm structures will each be marked with clearly visible UICs which can be seen by both vessels at sea level and aircraft (helicopters and fixed wing) from above; and

- The UICs shall each be illuminated by a low-intensity light visible from a vessel, thus enabling the structure to be detected at a suitable distance to avoid a collision with it. The size of the UICs in combination with the lighting will be such that, under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer, stationed 3m above sea levels, and at a distance of at least 150m from the WTG.

Operation:

- The Marine Control Centre(s), or mutually agreed single contact point, will be manned 24 hours a day;

- All MRCCs (MOC and/or MRSC) will be advised of the contact telephone number of the Central Control Room, or single contact point (and vice versa); and

- The control room operator, or single contact point, will immediately initiate the shut-down procedure for WTGs as requested by the MRCC (MOC and/or MRSC), and maintain the WTG in the appropriate shut-down position, as requested by the MRCC (MOC and/or MRSC), until receiving notification from the MRCC that it is safe to restart the WTG.

20.3.1 Effect on SAR Helicopter Operations

There is the potential for the operational stage of the proposed wind farms to effect SAR helicopters, including access for emergency response within the WTG arrays.

The wind farm sites will be designed to satisfy the following requirements for emergency response in or around the wind farms, as per MGN 371 (Ref. i):

- The WTG shall have high contrast markings (dots or stripes) placed at 10m intervals on both sides of the blades to provide helicopter pilots with a hover-reference point; and

- All SAR helicopter bases will be supplied with an accurate chart of all the offshore wind farm structures and their GPS positions.

It is noted that there could be the possibility that emergency response may only be possible from surface units (lifeboats) given restrictions on helicopter access in a wind farm. However, to aid helicopter SAR, there are specific requirements to allow safe helicopter operations within wind farms and close to, or over, WTGs:

- Emergency evacuation of persons directly from a WTG nacelle by SAR helicopter is a last resort. It will normally be considered where risk to life is such that the speed of reaction and transfer of survivors to a place of safety or of injured persons directly to shore medical facilities can most effectively be achieved by SAR helicopter;

- If winching is to take place to/from a WTG, the blades will have to be feathered and the rotor brakes applied (where feasible blades should be pinned). The nacelle should be rotated so that the blades are at 90 degrees off the wind with the wind blowing on to the left side of the nacelle e.g., if wind is blowing from 270 degrees, the nacelle will need to be rotated to the right so that the hub is facing 360 degrees;

- If winching is to take place to/from a nacelle, wherever possible wind farm personnel should be in the nacelle to assist the winch man;

- In poor visibility or at night, any lighting on WTGs may be required to be switched on or off at the discretion of the helicopter pilot; and

- For SAR helicopter operations, radar is a prime flight safety tool, especially at night and in bad weather/poor visibility. For safe operation of SAR helicopters within and around wind farms, it is crucial that the WTGs are detectable to airborne radars (at a safe range) and that the aircraft crew, using radar, can discriminate between individual WTGs.

In terms of the effect on SAR helicopters, based on the MGN 371 guidance and industry best-practice, including the development of ERCoPs, any effect on SAR helicopter operations can be well managed.

21. ADDITIONAL NAVIGATION ISSUES

21.1 *Introduction*

There are a number of additional navigational issues identified within MGN 371 (Ref. i) which are required to be addressed. The following subsections cover additional navigation related issues which have not been covered elsewhere within this report.

21.2 *Visual Navigation and Collision Avoidance*

21.2.1 Introduction

MGN 371 identifies the potential for visual navigation to be impaired by the location of offshore wind farm structures, based on vessels not being visible to each other (hidden behind structures) and navigational aids and/or landmarks not being visible to shipping.

21.2.2 Visual Impact (Other Vessels)

Based on the position, orientation, number of WTGs and spacing between WTGs it is not considered there will be any significant issue of visual impact between vessels on the main commercial shipping routes in the area.

During the maritime traffic surveys, recreational activity was recorded during the summer survey (June/July 2011), with fishing vessel activity being identified all year round in the general area. In the event of a small vessel (fishing or recreation) emerging from the wind farm towards shipping traffic, the vessel should be visible for the vast majority of the time due to the size of the WTGs relative to the large spacing between them.

21.2.3 Visual Impact (Navigational Aids and/or Landmarks)

It is likely that the proposed wind farm sites within Phase 1 will themselves form a significant aid to navigation, which will be highly visible to vessels due to the presence of lights on significant peripheral structures (SPSs), as well as on selected intermediate structures, in accordance with NLB requirements (see Section 4).

It is therefore considered that, providing suitable marking and lighting is used, the Phase 1 wind farms will not degrade the ability of vessels to navigate in the area through visual impairment of navigation aids or landmarks.

21.3 *Potential Effects on Waves and Tidal Currents*

From the physical environment assessment carried out as part of the ES, it was concluded that there will be no significant or measurable far field impact from either Project Alpha or Project Bravo on local tidal currents. Any impact on the waves will be very localised (in close proximity to the wind farm structures).

21.4 *Impacts of Structures on Wind Masking/Turbulence or Sheer*

The WTGs have the potential to affect vessels under sail when passing through the site from effects such as wind shear, masking and turbulence.

From previous studies of offshore wind farms it was concluded that WTGs do reduce wind velocity by the order of 10% downwind of a WTG. The temporary effect is not considered to be significant and is similar to that experienced passing a large ship or close to other large structures (e.g. bridges) or the coastline. In addition, practical experience to date from RYA members taking vessels into other wind farm sites indicates that this is not likely to be an issue.

21.5 *Sedimentation/Scouring Impacting Navigable Water Depths in Area*

There is the potential for structures positioned in the tidal stream to produce deposition of sediment or scouring which could affect the navigable water depths in the wind farm areas or adjacent to the area.

The physical environment assessment carried out as part of the ES has shown that no significant adverse deposition of sediment or scouring impacts are likely as a result of the Project Alpha and Project Bravo developments. It can therefore be stated that no impacts on navigation will result from the potential effects of the proposed Phase 1 wind farms on the physical environment.

21.6 *Structures and Generators affecting Sonar Systems in Area*

No evidence has been found to date with regard to existing offshore wind farms to suggest that they produce any kind of sonar interference which is detrimental to the fishing industry, or to military systems. No impact is anticipated for the proposed Phase 1 wind farms.

21.7 *Electromagnetic Interference on Navigation Equipment*

Based on the findings of the trials at the North Hoyle Offshore Wind Farm (Ref. v), the WTGs and their cabling, both array and export cabling, did not cause any compass deviation during the trials. However, it is stated that, as with any ferrous metal structure, caution should be exercised when using magnetic compasses close to WTG towers.

It is noted that all equipment and cables will be rated and in compliance with design codes. In addition the cables associated with the wind farm will be buried, wherever possible, and any generated fields will be very weak and will have no impact on navigation or electronic equipment. No significant impact is anticipated for the proposed offshore wind farms and associated array and export cable works.

21.8 *Impacts on Communications and Position Fixing*

The following summarises the potential impacts of the different communications and position fixing devices used in and around offshore wind farms. The basis for the assessment is the trials carried out by the MCA at North Hoyle (Ref. v) and experience of personnel/vessels operating in and around other offshore wind farm sites.

21.8.1 VHF Communications (including Digital Selective Calling (DSC))

Vessels operating in and around offshore wind farms have not noted any noticeable effects on VHF (including voice and DSC communications). No significant impact is anticipated at the Phase 1 wind farms.

21.8.2 Navtex

The Navtex system is used for the automatic broadcast of localised Maritime Safety Information (MSI). The system mainly operates in the Medium Frequency radio band just above and below the old 500 kilohertz (kHz) Morse Distress frequency. No significant impact has been noted at other sites and none are expected at the Phase 1 wind farms.

21.8.3 VHF Direction Finding

During the North Hoyle Offshore Wind Farm trials, the VHF direction equipment carried in the lifeboats did not function correctly when very close to WTGs (within about 50m). This is deemed to be a relatively small scale impact and, provided the effect is recognised, it should not be a problem in practical emergency response.

21.8.4 Automatic Identification System (AIS)

In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e. blocking the line of sight). This was not evident in the trials carried out at the North Hoyle Offshore Wind Farm and no significant impact is anticipated for AIS signals being transmitted and received at the Phase 1 wind farms.

21.8.5 Global Positioning System (GPS)

No problems with basic GPS reception or positional accuracy were reported during the trials at North Hoyle Offshore Wind Farm and this has been confirmed from other vessels which have been inside offshore wind farms. Consideration must to be given to any potential degradation of Differential Global Positioning System (DGPS) signals being used to position construction equipment when close to a tower.

21.8.6 LORAN-C

LORAN-C is a low frequency electronic position-fixing system using pulsed transmissions at 100 kHz. The absolute accuracy of LORAN-C varies from 0.1 to 0.25nm. Its use is in steep decline, with GPS being the primary replacement. It is mostly used in ships on and near the United States (US) coast, although some GPS receivers have built-in LORAN-C software.

Attempts were made to test a system during the North Hoyle Offshore Wind Farm trial, but there were difficulties which were probably attributable to operational errors or lack of a nearby transmitter.

Although a position could not be obtained using LORAN-C in the wind farm area, the available signals were received without apparent degradation. The Phase 1 wind farms are not expected to have a significant impact on LORAN-C. It is noted that the Department for Transport are funding an enhanced LORAN (eLORAN) service in the UK which commenced on a 15 year contract in May 2007.

21.9 *Noise Impact*

21.9.1 Acoustic Noise Masking Sound Signals

A concern which must be addressed under MGN 371 is whether acoustic noise from the wind farm could mask prescribed sound signals. Research undertaken has indicated that the sound level from a wind farm at a distance of 350m is below a background sound level so it is not expected that wind farm noise will be an issue for mariners.

The 1972 International Regulations for Preventing Collisions at Sea (1972 COLREGS), ANNEX III, entered into force by the IMO, specifies the technical requirements for sound signal appliances on marine vessels. Frequency range and minimum decibel level output is specified for each class of ship (based on length).

A ship's whistle for a vessel of 75m should generate in the order of 138 dB and be audible at a range of 1.5nm. Therefore, this should be heard above the background noise of the wind farms. Foghorns will also be audible over the background noise of the wind farms.

Therefore, there is no indication that the sound level of the Phase 1 wind farms will have any significant influence on marine safety.

21.9.2 Noise Impacting Sonar

Based on lessons learnt and experience at other offshore wind farms, it is not believed that the subsea acoustic noise generated by the wind farm when operational will have any significant impact on sonar systems.

22. RISK MITIGATION MEASURES & MONITORING

22.1 *Mitigation*

This section summarises the main industry standard and best practice risk mitigation measures adopted by Seagreen for the proposed Project Alpha, Project Bravo and the Transmission Asset Project to reduce the navigational risk to an acceptable level.

Table 22.1 Mitigation Measures

Type of Mitigation	Mitigation	Description
Industry Standard	Marked on Admiralty Charts	The wind farms will be charted by the UK Hydrographic Office (UKHO) using the magenta WTG tower chart symbol found in publication 'NP 5011 - Symbols and Abbreviations used in Admiralty Charts'. Submarine cables associated with wind farms will also be charted on the appropriate scale charts.
Industry Standard	Information circulation	Appropriate liaison to ensure information on the wind farm sites and special activities is circulated in Notices to Mariners, Navigation Information Broadcasts and other appropriate media.
Industry Standard	Marking and lighting	Structures to be marked and lit in-line with NLB and IALA guidance. (See Section 4.)
Industry Standard	WTG air draught	Lowest point of rotor sweep at least 22m above Mean High Water Springs as per MCA MGN 371.
Industry Standard	Cable burial and protection	Cables will be protected appropriately taking into account fishing and anchoring practices. Positions of the cable routes notified to Kingfisher Information Services-Cable Awareness (KIS-CA) for inclusion in cable awareness charts and plotters for the fishing industry.
Industry Standard	Compliance with MCA's Marine Guidance Notice (MGN) 371 including Annex 5	Annex 5 specifies 'Standards and procedures for generator shutdown and other operational requirements in the event of a search and rescue, counter pollution or salvage incident in or around an OREI.'
Industry Standard	Formulation of an Emergency Response Cooperation Plan (ERCoP) as per MCA template	Seagreen will use the draft template created by the MCA to formulate ERCoPs and site Active Safety Management Systems, in consultation with the MCA.
Best Practice	Guard Vessels	There will be appropriate guard vessel coverage during construction/decommissioning.
Best Practice	Safety Zones	500m zones planned during construction, decommissioning and major maintenance, and 50m zones during operation, will be applied for in order to guard against vessels approaching

Type of Mitigation	Mitigation	Description
		dangerously close to the structures.

Discussions on other measures will continue both pre- and post-construction and during the life of the projects with the MCA and other relevant stakeholders.

22.2 *Future Monitoring*

22.2.1 Safety Management Systems

From a navigation risk perspective, monitoring will take place through the project's Safety Management System (SMS). The SMS will include an incident/accident reporting system which will allow incidents and near misses to be recorded and reviewed to monitor the effectiveness of the risk control measures in place at the site. In addition to this any information gleaned from near misses/accidents at other offshore wind farm site will be considered with respect to the control measures applied at the Phase 1 wind farms.

During maintenance, there will regularly be vessels operating in the site which can monitor any third party vessel activity, both visually and on radar, although this will not be their primary function.

22.2.2 Close-circuit Television (CCTV)

CCTV may be installed to enable coverage of the proposed wind farms from key locations either on the WTG structures or the OSPs. CCTV technology can be adjustable for day/night conditions, which will allow operators in a central control room to identify vessel names from a distance to facilitate radio communications.

22.2.3 Future Monitoring of Marine Traffic

Whilst no radar monitoring of vessel movements has been proposed for the site, AIS monitoring should be explored to monitor and record the movements of vessels around the Phase 1 wind farm sites and associated export cables to shore, as well as company vessels working at the wind farms.

There will also be vessels regularly operating in the site, including during maintenance, which can monitor any third party vessel activity both visually and on radar, although this will not be their primary function.

22.2.4 Subsea Cables

The subsea cable routes will be subject to periodic inspection to monitor cable burial depths.

22.2.5 Hydrographic Surveys

Annex 2, Section 6 of MGN 371 states that *"In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are required"*.

Future hydrographic surveys will cover the Project Alpha, Project Bravo and Transmission Asset sites and their immediate environs extending to 500m outside the development area and be undertaken on a pre-established periodicity during the life of the projects.

23. CONCLUSIONS

Following a review of the baseline shipping and navigation, a NRA for the proposed Phase 1 wind farms (Project Alpha and Project Bravo) has been undertaken. Analysis of the export cable has been provided in a separate report (see Appendix A).

The assessment has included collision risk modelling and a formal safety assessment for all stages of the projects (construction, operation/maintenance and decommissioning) as well as an assessment of cumulative and in combination impacts. A summary of the main conclusions of the NRA are presented below:

- The main routes to be impacted by the Project Alpha and Project Bravo wind farms are those which run north to south or north east to south west through the sites, primarily between Aberdeen/other Northern Scottish ports and Humber/European ports. The estimated deviation for vessels is estimated to be 2.4nm at most, assuming that vessels seek to pass 1nm from the wind farm boundaries.

- In the hazard review workshop involving local navigational stakeholders, no hazards were assessed to be unacceptable.

- Following identification of the key navigational hazards, risk analyses were carried out to investigate selected hazards in more detail. For Project Alpha the overall annual level of collision risk was estimated to increase due to the proposed wind farm by approximately 1 in 47 years (base case) and 1 in 43 years (future case). For Project Bravo, the overall annual level of collision risk was estimated to increase due to the proposed wind farm by approximately 1 in 89 years (base case) and 1 in 81 years (future case). In both cases, the vast majority of this risk is from fishing vessel collisions given the assumption that fishing vessels maintain their current activity levels within the site following development.

- The risks associated with recreational craft interaction with the proposed wind farm structures (blade/mast and vessel/structure collisions) were qualitatively assessed and concluded to be as low as reasonably practicable given the mitigation measures planned.

- A quantitative assessment estimated that, compared to the background marine accident risk levels in the UK, the increase in risk to both people and the environment caused by the proposed wind farms is low.

- Additional potential navigational impacts associated with the construction and decommissioning stages of the wind farms and transmission asset have been quantitatively discussed and considered in the hazard review. Further hazard/risk assessment workshops will be carried out as part of the projects planning process to help ensure the different activities taking place are carried out safely.

- In terms of cumulative and in-combination issues from nearby developments including Inch Cape and Neart na Gaoithe, it was concluded that traffic will mainly deviate to the east of the Phase 1 wind farms thus increasing the density of traffic on this route. Other shipping routes which will be cumulatively affected include the route passing east-west through the Phase 1 wind farm sites which will deviate to the south.

- Mitigation and safety measures will be applied to the proposed wind farms and transmission asset appropriate to the level and type of impacts determined during the EIA. The specific measures to be employed will be selected in consultation with the MCA Navigation Safety Branch and other relevant statutory stakeholders where required.

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Export Cable Route Report

Phase 1

(Appendix A)

Prepared by:	Anatec Limited
Presented to:	Seagreen
Date:	5th July 2012
Revision No.:	00
Ref.:	A2520-SEA-NRA-1 App A

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TABLE OF CONTENTS

A1. INTRODUCTION

1.1 Background

Anatec was commissioned by Seagreen Wind Energy Limited (Seagreen) to perform a shipping and navigation assessment of the proposed export cable route (ECR) from the Phase 1 offshore wind farms (Project Alpha and Project Bravo), located in the outer Firth of Forth, off the east coast of Scotland.

This report presents the navigational risk assessment for the ECR which makes landfall south of Carnoustie including the baseline marine activity and navigational features for the area.

Seagreen intends to apply for the consent required for the offshore transmission infrastructure, with assets likely to be transferred to an OFTO (Offshore Transmission Operator) for construction, operation and decommissioning.

1.2 Study Scope

The assessment covers the following maritime activities:

- Commercial Shipping;
- Recreational Sailing; and
- Fishing.

In addition to these activities, consideration is given to the following:

- Navigational Features;
- Nearby Ports/Harbours;
- Military Exercise Areas; and
- Maritime Incidents.

1.3 Study Area

Note that the original study area used in the analysis within this report was a 10nm buffer around the Export Cable Route Corridor, which has changed during the process of carrying out the work. The change was not considered significant enough to merit a full update as the buffer still provides a minimum of 8nm coverage of the ECR.

1.4 Data Sources

The main data sources used in this assessment are listed below:

- Automatic Identification System (AIS) and radar survey data from two surveys *EEMS* (March 2011) and *Highland Eagle* (June/July 2011);
- The Forth and Tay Offshore Wind Developers Group (FTOWDG) AIS data (November 2009 to May 2010) from coastal survey sites;
- Fishing Surveillance Data (Sightings 2005-2009 and Satellite 2009);
- Maritime Incident Data (Marine Accident Investigation Branch (MAIB) 2001-2010 and Royal National Lifeboat Institution (RNLI) 2001-2010);
- UK Coastal Atlas of Recreational Boating (Ref. i);
- UK Admiralty Charts 1407 and 1409; and
- Admiralty Sailing Directions (NP 54). (Ref. ii)

1.5 Abbreviations

The following abbreviations are used in this report:

AC	-	Alternating Current
AIS	-	Automatic Identification System
ALB	-	All-weather Lifeboat
BPI	-	Burial Protection Index
CA	-	Cruising Association
DIO	-	Defence Infrastructure Organisation
ECR	-	Export Cable Route
EU	-	European Union
FTOWDG	-	Forth and Tay Offshore Wind Developers Group
GT	-	Gross Tonnage
HVDC	-	High Voltage Direct Current
ILB	-	Inshore Lifeboat
KIS-CA	-	Kingfisher Information Services-Cable Awareness
km	-	Kilometre
m	-	Metres
MAIB	-	Marine Accident Investigation Branch
MCA	-	Maritime and Coastguard Agency
MEHRA	-	Marine Environmental High Risk Area
MMO	-	Marine Management Organisation
nm	-	Nautical Miles
NLB	-	Northern Lighthouse Board
NRA	-	Navigational Risk Assessment
NtM	-	Notices to Mariners
OFTO	-	Offshore Transmission Operator
PEXA	-	Practice and Exercise Area
PLN	-	Port Letter Number
RNLI	-	Royal National Lifeboat Institution
RYA	-	Royal Yachting Association
SFI	-	Sea Fisheries Inspectorate
SMS	-	Safety Management System
UK	-	United Kingdom
UKHO	-	United Kingdom Hydrographic Office
VHF	-	Very High Frequency

A2. WIND FARM DEVELOPMENT DETAILS

2.1 Introduction

This section presents details of the Phase 1 offshore wind farms (Project Alpha and Project Bravo) and ECR corridor which are located in the outer Firth of Tay off the Angus coastline.

2.2 Wind Farm Boundaries

The proposed Project Alpha and Project Bravo sites are located in Phase 1 of the Firth of Forth Round 3 development Zone 2. Phase 1 lies 12nm[1] east of Red Head, just north of Arbroath on the Angus coast, and the boundary of Project Alpha is located 18nm east of the Scottish coast.

2.3 Overview of Offshore Cable Routes

An overview of the ECR relative to Project Alpha and Project Bravo is presented in Figure 2.1.

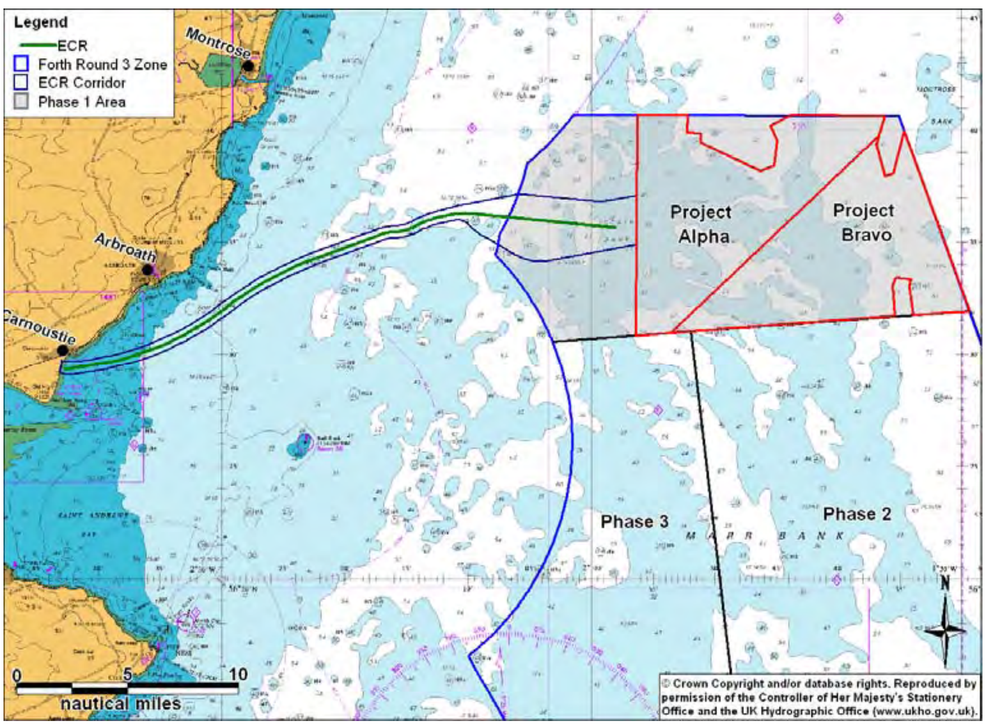

Figure 2.1 Chart of ECR relative to Phase 1 Wind Farms

Preliminary export cable route investigation works for the project state that the cable will be trenched (where seabed conditions allow) to a minimum depth of 0.5 metres (m) and to a maximum depth of 3m. For trenched cables the estimated width per trench is 3m and the width of the temporary zone of influence is 15m. Where seabed conditions do not permit

[1] 1 nautical mile = 1.852 kilometres

burial, an assessment will be made regarding other means of protection (such as rock dumping and mattress protection) and/or if protection is required.

A detailed chart of the ECR making landfall approximately 0.75nm south of Carnoustie is presented in Figure 2.2.

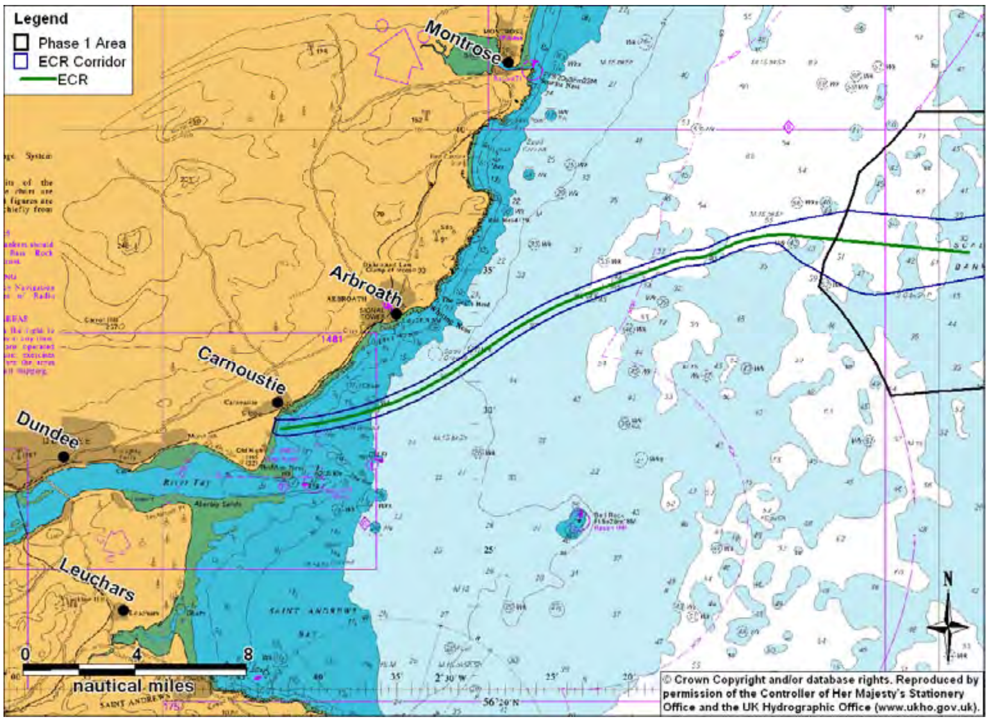

Figure 2.2 Chart of ECR

A3. EXISTING ENVIRONMENT

3.1 Introduction

This section presents the following baseline information relating to navigation in the area for the ECR:

- Navigational Features and Military Exercise Areas
- Ports/Anchorages
- Marine Environmental High Risk Areas (MEHRAs)

3.2 Navigational Features and Military Exercise Areas

A chart of nearby ports, harbours and anchorage areas relative to the ECR extracted from the Admiralty Sailing Directions for the area (Ref. ii) is presented in Figure 3.1.

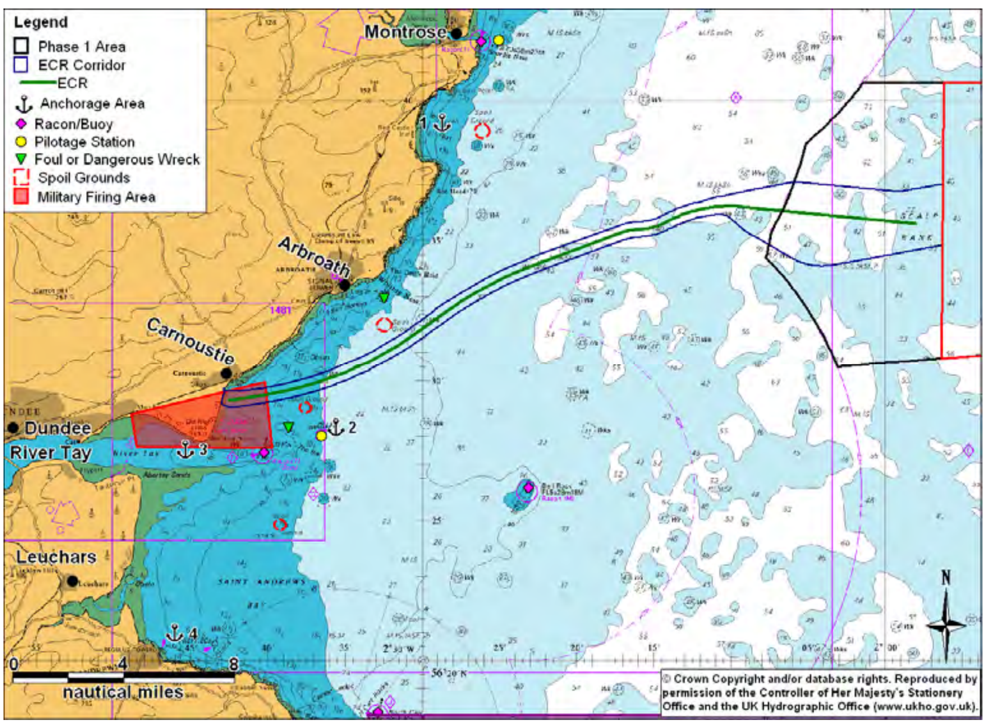

Figure 3.1 Navigational Features relative to ECR

In general it can be seen that the ECR is clear of the main navigational features in the area (e.g. Bell Rock, the River Tay approach channel and the charted anchorage in Lunan Bay).

The ECR intersects part of the Barry Buddon Military Practice and Exercise Area (PEXA) D604 (weapons firing and demolition) off Buddon Ness on the northern side of the River Tay.

The ECR passes 2nm north of the River Tay Pilotage station and 0.8nm north of a charted spoil ground. Admiralty Sailing Directions for the area also indicate that an anchorage is available approximately 0.6nm west south west of Buddon Ness where the water depth is approximately 6m (Ref. ii).

There is a charted foul 1nm south of the ECR. The foul is charted at 4.2m and is to be avoided by vessels anchoring or trawling as it could pose a snagging hazard to them.

3.3 Anchorage Areas

The following anchorage areas have been identified from charts and the pilot book (Ref. ii) for the area (numbered one to four on Figure 3.1):

1. Lunan Bay, which lies between Boddin Point and Red Head, is sandy and free from dangers, apart from the rocky ledges off the Point and Head. There is a good anchorage in the bay 1nm east of the ruins of Red Castle in depths of 14m where the seabed type is sand over clay;
2. An anchorage is available approximately 4.5nm east of Buddon Ness in the vicinity of the Fairway Light Buoy where the water depth is around 20m;
3. There is also an anchorage 0.6nm west south west of Buddon Ness where the water depth is approximately 6m; and
4. There is a charted anchorage in St Andrews Bay, approximately 0.8nm from the coast in a water depth of around 8m.

An analysis of anchored vessels in the vicinity of the ECR is presented in Sections 5.4 and 5.6.

3.4 Marine Environmental High Risk Areas (MEHRAs)

Marine Environmental High Risk Areas (MEHRAs) are areas that have been identified by the UK Government as areas of environmental sensitivity and at high risk of pollution from ships. The UK Government expects mariners to take note of MEHRAs and either keep well clear or, where this is not practicable, exercise an even higher degree of care than usual when passing nearby.

There is a MEHRA located approximately 19nm south of the ECR around the Isle of May (Figure 3.2). This MEHRA has been designated on wildlife, landscape and geological grounds.

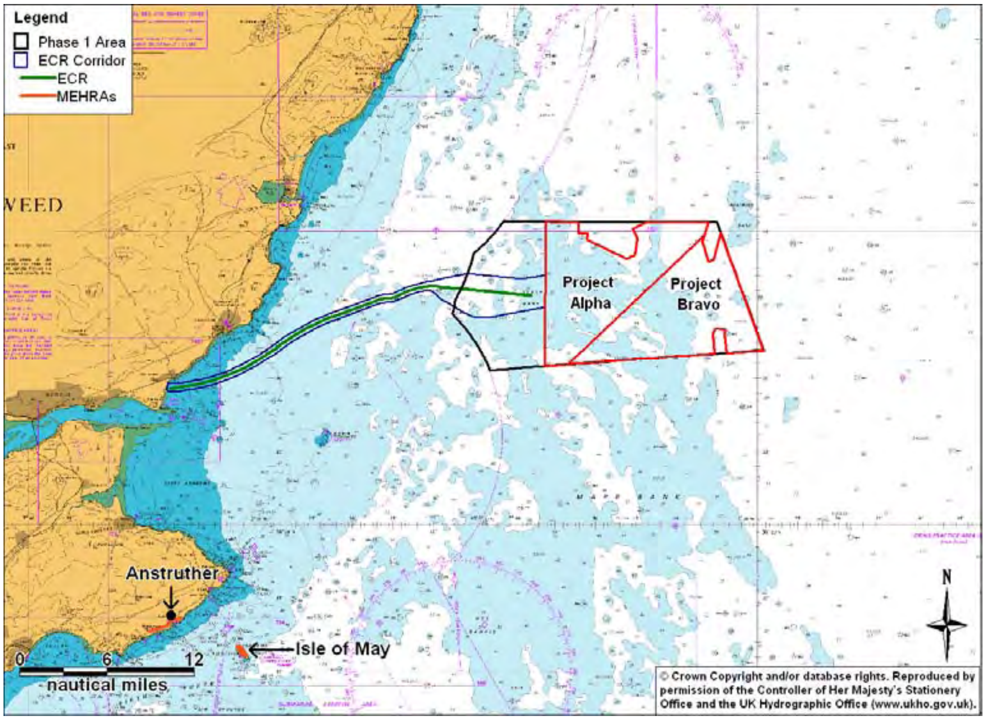

Figure 3.2 MEHRAs relative to ECR

A4. MARITIME INCIDENTS

4.1 Introduction

This section reviews maritime incidents that have occurred in the vicinity of the ECR in the ten year period from 2001 to 2010.

The analysis is intended to provide a general indication as to whether the area of the ECR is currently low or high risk in terms of maritime incidents. If it was found to be a particular high risk area for incidents, this may indicate that the development could exacerbate the existing maritime safety risk in the area. Data from the following sources has been analysed:

- Marine Accident Investigation Branch (MAIB)
- Royal National Lifeboat Institution (RNLI)

It is noted that the same incident may be recorded by both sources.

4.2 MAIB

All UK-flagged commercial vessels are required to report accidents to the MAIB. Non-UK flagged vessels do not have to report unless they are within a UK port/harbour or within UK 12nm territorial waters and carrying passengers to or from a UK port (including those in inland waterways).

However, the MAIB will record details of significant accidents of which they are notified by bodies such as the Coastguard, or by monitoring news and other information sources for relevant accidents. The Maritime and Coastguard Agency (MCA), harbour authorities and inland waterway authorities also have a duty to report accidents to MAIB.

The locations[1] of accidents, injuries and hazardous incidents reported to MAIB in the vicinity of the ECR between January 2001 and December 2010 are presented in the following subsections.

[1] MAIB aim for 97% accuracy in reporting the locations of incidents.

4.2.1 ECR MAIB Incidents

MAIB incidents within 10nm of the ECR between January 2001 and December 2010 are presented in Figure 4.1, colour-coded by type.

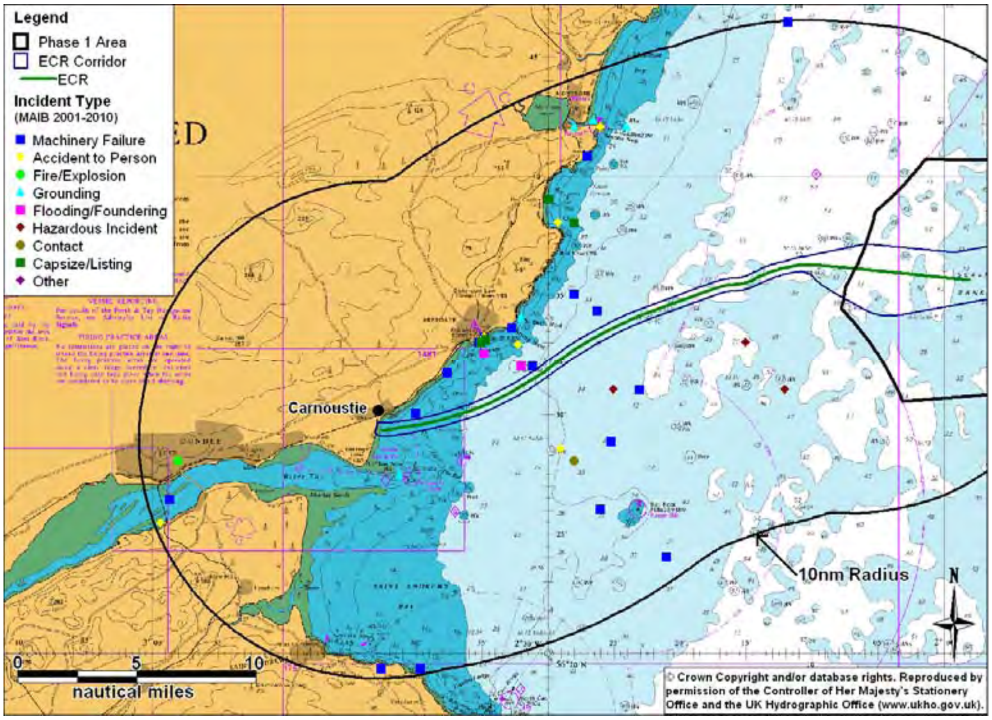

Figure 4.1 MAIB Incident by Type within 10nm of ECR

A total of 49 incidents were recorded within 10nm of the ECR over the ten years analysed, involving 52 vessels, corresponding to an average of five incidents per year.

No incidents were recorded within the cable route corridor. There were three machinery failures (out-with a port or harbour) within 1nm of the cable route. It is noted that emergency anchoring can occur during a machinery failure (e.g. engine failure, steering gear problems or fouled propeller), which could pose an anchor snagging risk.

A summary of the three closest machinery failures to the ECR is provided below:

- In December 2001 a wooden hulled fishing vessel (18.5m in length and 75 Gross Tonnage (GT)) had a machinery failure 0.4nm north of the ECR in moderate sea conditions, Beaufort 0-3;
- The second closest machinery failure was recorded on a fishing vessel (8.2m in length and 4.4GT) in June 2002 approximately 0.5nm north of the ECR; and
- The third closest machinery failure was recorded 0.5nm south of the ECR when a 5m potter (static) fishing vessel ran over a suspected rope. The spare outboard engine also had a mechanical failure. Therefore the skipper decided to jettison three of the

creels/pots and row back to shore; however the wind was too strong. The Inshore Life Boat (ILB) was called out (arriving in 15 minutes) to tow the vessel back to port.

The distribution by incident type is presented in Figure 4.2.

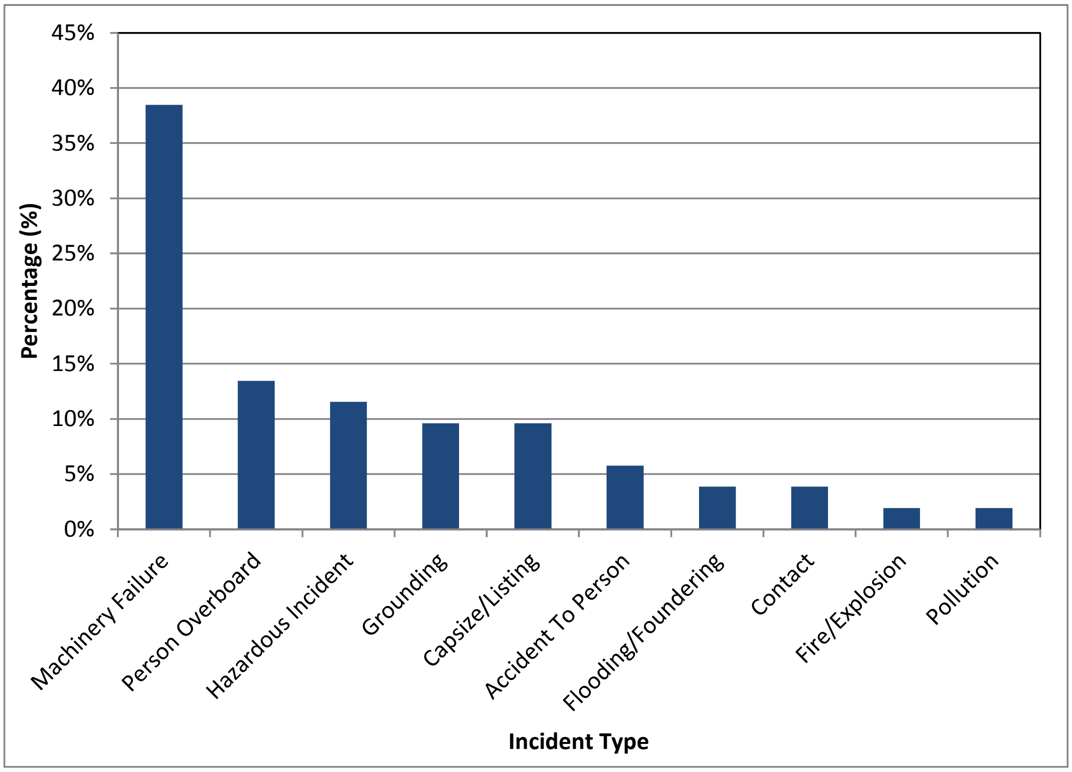

Figure 4.2 MAIB incidents by type within 10nm of ECR (2001-2010)

The most common incident type recorded within 10nm of the ECR was machinery failure, representing 38% of all incidents over the ten year period analysed.

4.3 RNLI

Data on RNLI lifeboat responses in the vicinity of the ECR in the ten-year period between 2001 and 2010 have been analysed. There are two types of RNLI lifeboats that can respond to incidents (All Weather Lifeboats (ALB) and Inshore Lifeboats (ILB)). The type of lifeboat is noted when describing incidents near the ECR.

The following subsections analyse the RNLI incidents within 10nm of the ECR.

4.3.1 ECR RNLI Incidents

A total of 535 unique incidents were recorded within 10nm of the ECR over the ten years analysed, corresponding to an average of 54 incidents per year.

Figure 4.3 presents the geographical location of incidents colour-coded by casualty type. It can be seen that the vast majority occurred near the coast (i.e. off Arbroath, St Andrews and within the Firth of Tay) with relatively few further out to sea.

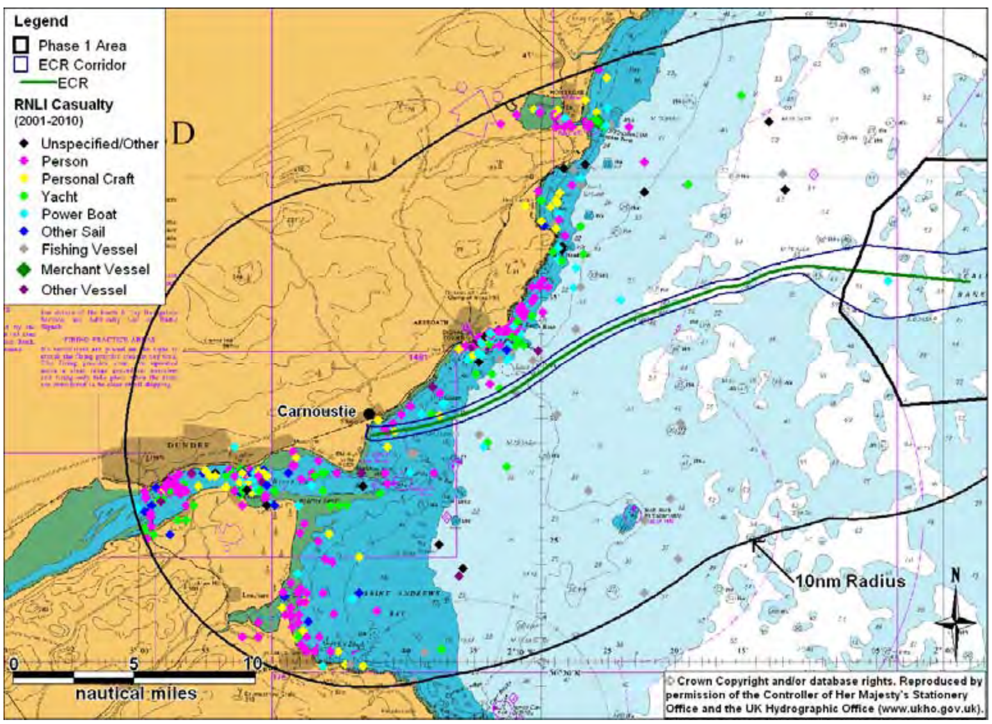

Figure 4.3 RNLI Incidents by Casualty Type within 10nm of ECR

In general, most incidents occurred within 0.6nm of the shore involved accidents to people and personal craft (i.e. sail board or canoe/kayak).

A total of five incidents were recorded within the cable route corridor and further details are provided below:

- Adverse conditions lead to a sail board getting into difficulty, with Broughty Ferry ALB and ILB responding to the incident in April 2001;
- A search for a missing person occurred in April 2008 with Broughty Ferry ILB responding. It is noted that the person was not found;
- Arbroath ILB responded to a drowning bather 0.1nm north of the cable (approximately 0.5nm from shore) in August 2002;
- A machinery failure occurred on a small inflatable angling vessel 0.2nm north-north-west of the ECR in April 2006, with Arbroath ALB assisting the vessel; and
- A man overboard was recorded on a small fishing vessel 0.2nm south east of the ECR in August 2007, with Broughty Ferry ALB assisting the vessel.

The overall distribution by casualty type is summarised in Figure 4.4.

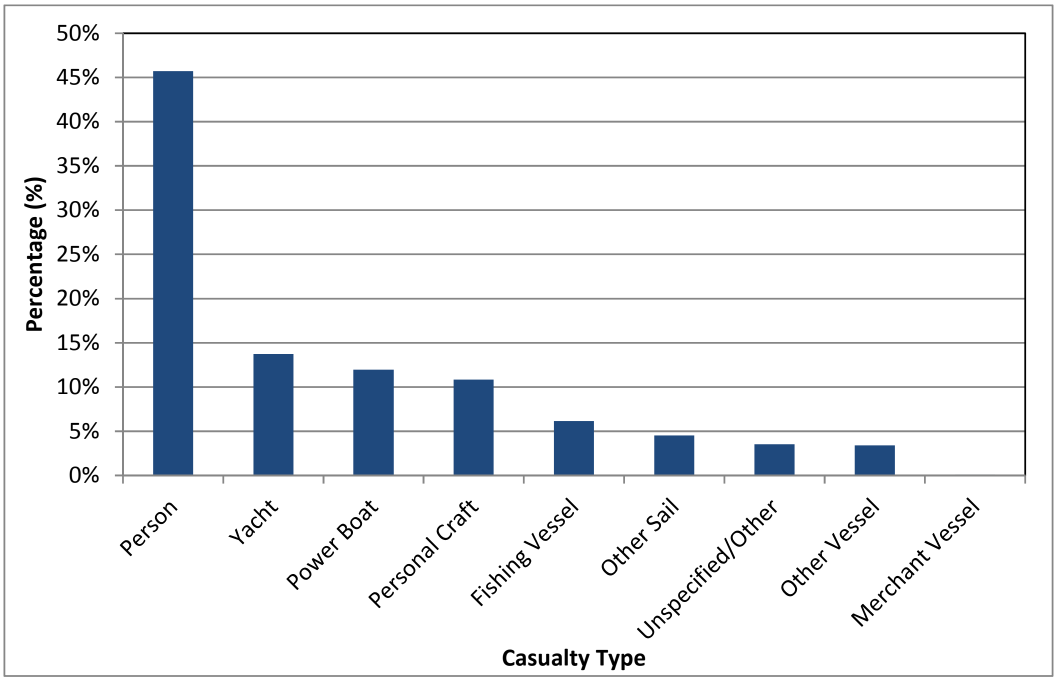

Figure 4.4 RNLI Incidents by Type within 10nm of ECR (2001-2010)

Accident to person (46%) was the most common casualty types involved. The remainder of casualties generally consisted of recreational vessels, i.e. yachts/other sail (19%), personal craft (11%), with fishing vessels accounting for (6%).

It is noted that there was one incident (0.2% of the total) which involved a merchant vessel recorded during the ten years analysed. This incident involved a large commercial vessel which experienced a steering gear failure 8.8nm north of the ECR in November 2002. Montrose ALB responded, but no action was required.

A chart of the incidents by cause is presented in Figure 4.5.

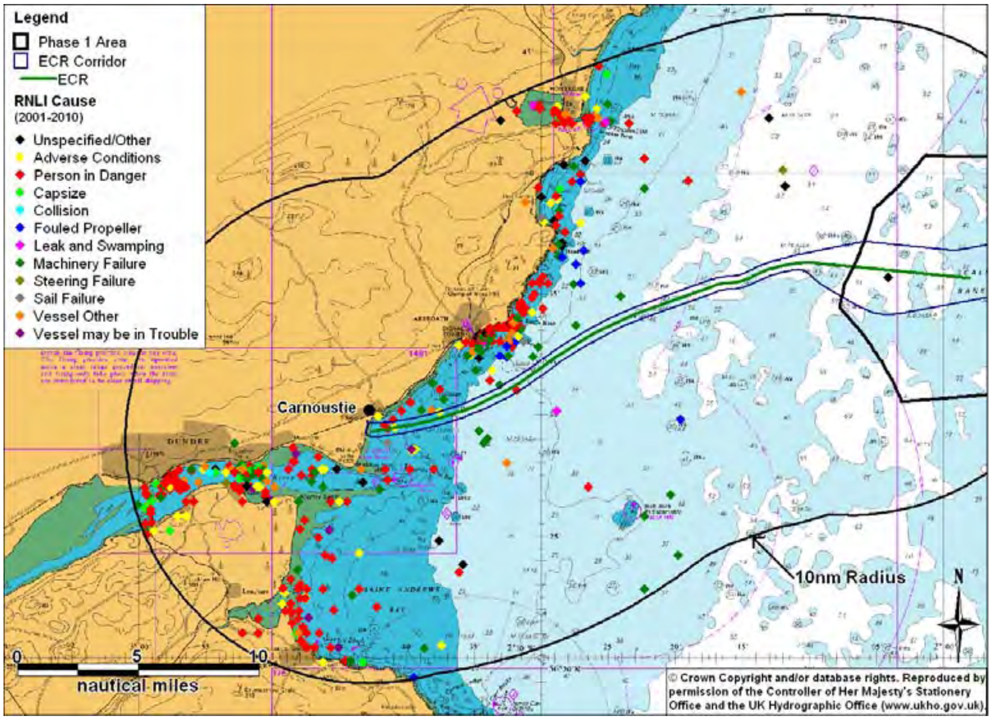

Figure 4.5 RNLI Incidents by Cause within 10nm of ECR

The main reported causes were person in danger (55%) and machinery failure (16%). The annual rate of incidents in the ten years analysed is summarised in Figure 4.6.

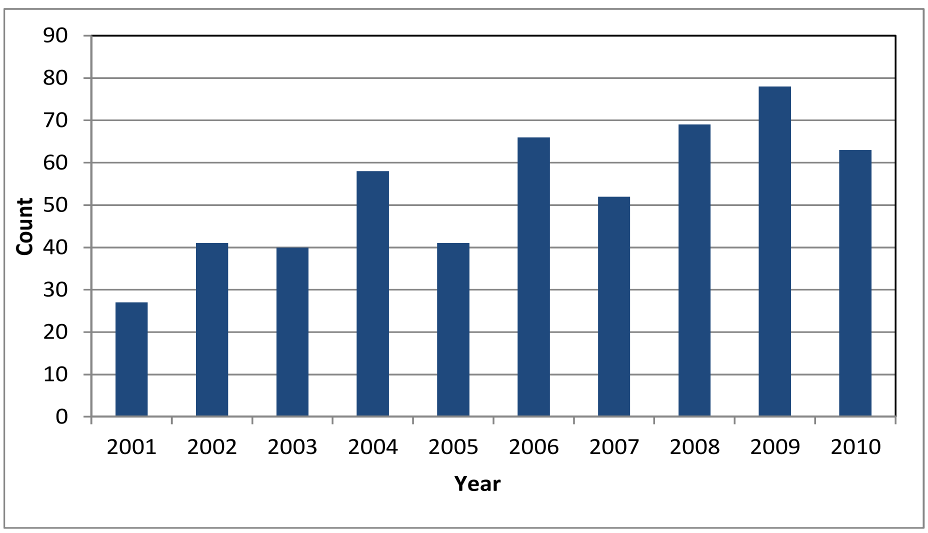

Figure 4.6 RNLI Incidents by Year within 10nm of ECR (2001-2010)

There were an average of 54 RNLI incidents per year recorded within 10nm of the ECR and the year with the most incidents was 2009 when 78 were recorded.

From the ten year period of RNLI data analysed (2001-2010), Broughty Ferry ALB (stationed approximately 6nm west south west of the ECR) responded to 56% of incidents, with Arbroath ALB (approximately 3nm north of the ECR) responding to 31% of incidents within 10nm of the ECR.

4.4 Conclusions

Based on the review of incidents, it can be seen that there have been a relatively low rate of accidents in recent years within 10nm of the ECR.

Most incidents in the area have occurred in the Firth of Tay and within 2nm of the coastline (i.e. off Arbroath and St Andrews).

A5. MARITIME TRAFFIC SURVEYS

5.1 Introduction

This section summarises the results of the maritime traffic surveys carried out for Project Alpha, Project Bravo and the ECR. The data presented uses a combination of coastal-based AIS and AIS data collected from vessels recording shipping during surveys of the Phase 1 wind farms (March and June/July 2011).

Full details of the maritime traffic surveys carried out for the Phase 1 offshore wind farms can be found in Appendices E and F of the NRA.

5.2 Survey Details

The main maritime traffic surveys were carried out from *EEMS* and *Highland Eagle* which recorded AIS (and non-AIS radar) shipping data for the Phase 1 wind farm projects. Data recorded including coverage of the ECR; however it is noted that radar data coverage is not comprehensive out-with the Phase 1 boundary due to limitations in radar tracking range (approximately 12nm).

The vessel based surveys took place during March 2011 (14 days) and June/July 2011 (26 full days); with a combined total of 40 days data collected for Phase 1 and the ECR. Images of these vessels are presented in Figure 5.1 and Figure 5.2.

Figure 5.1 Survey Vessel *EEMS*

Figure 5.2 Survey Vessel *Highland Eagle*

Coastal AIS data was also recorded by the Firth and Tay Offshore Wind Developers Group (FTOWDG) coastal stations. This data served to validate the *EEMS* and *Highland Eagle* findings and present data over additional seasonal fluctuations in the area. Data was extracted from 28 days in June 2010 and 28 days in November 2010, giving a combined total of 56 days for the analysis.

The following sections present the marine traffic data coloured-coded by vessel type (where available).

5.3 Shipping Survey Data (2011)

5.3.1 Overview of Survey Data

A chart of the vessel tracks recorded on AIS within 10nm of the ECR during the 40 day survey period, colour-coded by vessel type is presented in Figure 5.3. Non-routine vessels including survey ships were removed from the data set to focus the analysis on passing shipping.

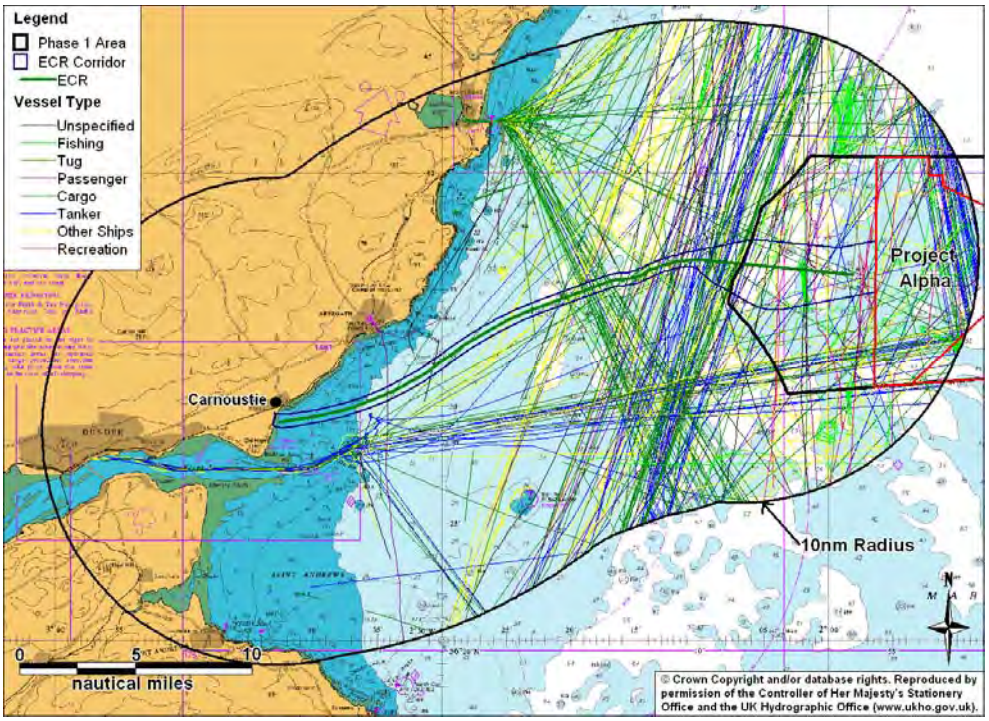

Figure 5.3 Combined Survey Data by Vessel Type (40 days) 10nm around ECR

The number of unique vessels intersecting the ECR averaged four vessels per day.

As can be observed from the marine traffic data, the majority of vessel tracks intersecting the ECR were headed in a north east-south west direction to/from the Firth of Forth and a north west-south east direction to/from Montrose.

Vessels were also recorded waiting and/or at anchor 0.5nm south of the ECR (north of the Tay Pilotage station).

Figure 5.4 presents the type distribution for vessels passing within 10nm of the ECR (excluding 3% unspecified).

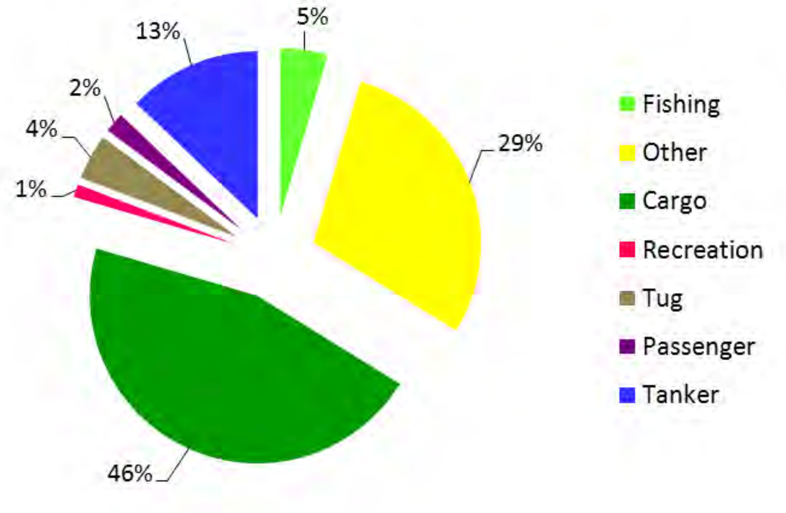

Figure 5.4 Vessel Type Distribution within 10nm of ECR

Cargo vessels were the most common type of vessel within 10nm of the ECR comprising 46% of traffic. 'Other ships' (mainly offshore vessels) made up 29% of traffic. Tankers and fishing vessels made up 13% and 5% of recorded marine traffic respectively.

5.4 Shipping Survey (2011) - Anchored Vessels

5.4.1 ECR Anchoring Activity

The positions of vessels recorded at anchor during the combined *EEMS* and *Highland Eagle* surveys (40 days) relative to the ECR are presented in Figure 5.5.

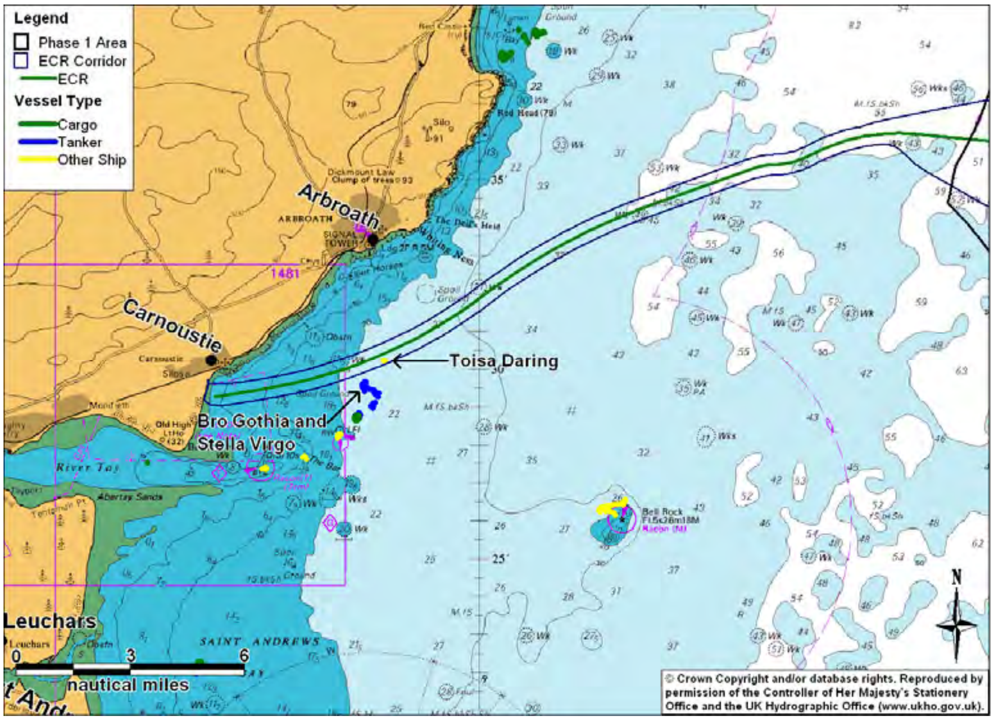

Figure 5.5 ECR Anchored Vessels during Combined Surveys (40 days)

It can be observed that a number of vessels were recorded at anchor approximately 0.8nm south of the ECR (within 2nm of the Tay Pilotage station). Vessels were also recorded at anchor within Saint Andrews Bay which is located 7.5nm south of the ECR and within Lunan Bay which is approximately 5nm to the north.

One vessel was recorded at anchor within the cable route corridor, with two tankers anchoring within 1nm of the ECR. A summary of the vessels recorded at anchor within 1nm of the ECR is presented below:

- Offshore support vessel *Toisa Daring* (70m in length, broadcasting a draught of 5.8m) was recorded anchored within the cable route corridor (destination Dundee);
- The second closest vessel recorded at anchor was a chemical/products tanker *Bro Gothia* (119m in length, broadcasting a draught of 6.2m) recorded approximately 1nm south of the ECR for two days (destination Dundee); and

- The third closest vessel recorded at anchor was a chemical/products tanker *Stella Virgo* (103m in length, broadcasting a draught of 5m) recorded approximately 1nm south of the ECR for two days (destination Dundee).

5.5 Coastal Survey AIS Data (2010)

5.5.1 Overview of Coastal Survey Data

This section presents a combined dataset of two months AIS shipping data collected from coastal AIS surveying by FTOWDG. One month of summer AIS data (28 days from June 2010) and one month of winter data (28 days from November 2010) has been extracted and combined to validate the shipping surveys carried out in 2011.

A chart of the vessels recorded within 10nm of the ECR from the FTOWDG coastal AIS data is presented in Figure 5.6 (colour-coded by vessel type).

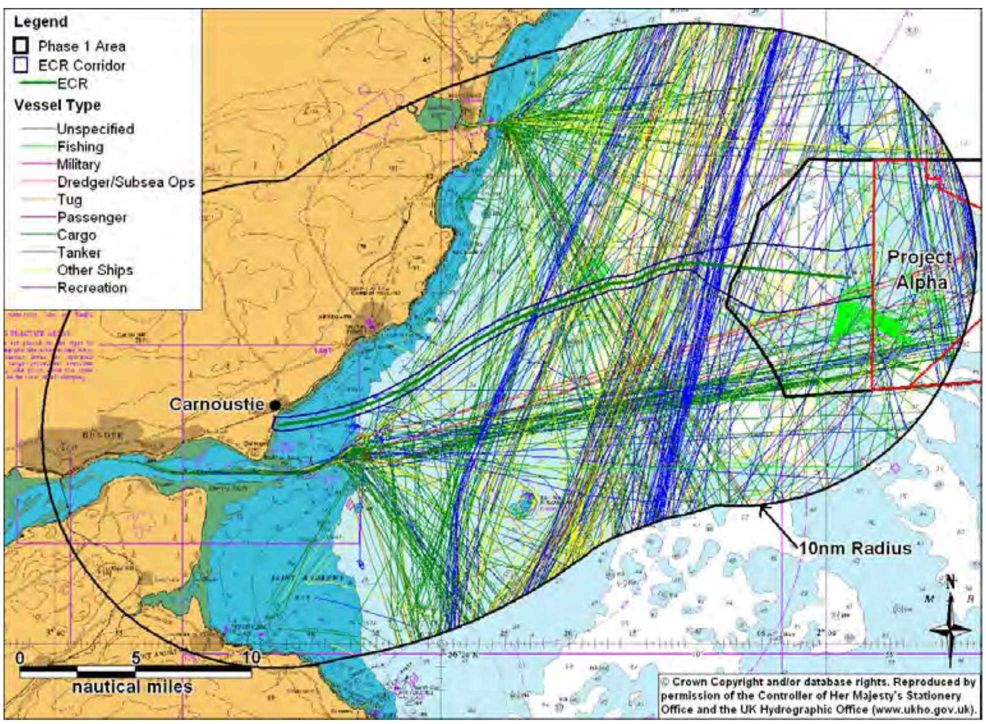

Figure 5.6 AIS Coastal Data by Vessel Type June and November 2010 (56 days)

Comparing the data collected from *EEMS* and *Highland Eagle* it can be observed that vessel routeing was comparable during the two surveys.

5.6 Coastal Survey AIS (2010) - Anchored Vessels

5.6.1 ECR Anchoring Activity

The positions of vessels at anchor recorded from the coastal surveys in June 2010 and November 2010 is presented in Figure 5.7.

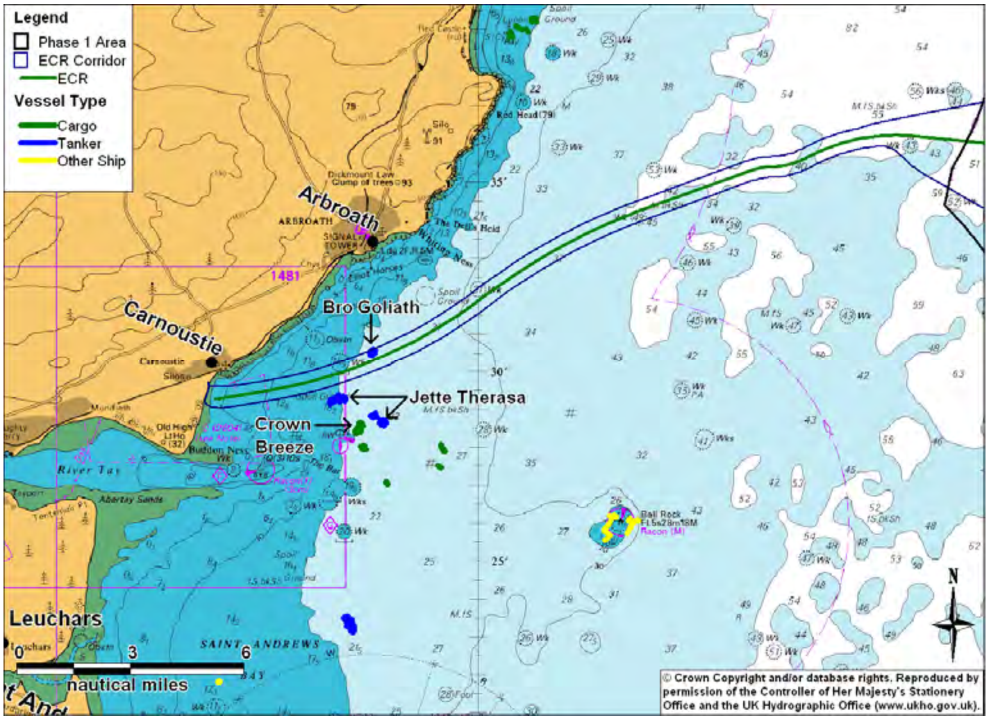

Figure 5.7 ECR Anchored Vessels during Combined June and November 2010 (56 days)

From the coastal survey data, it can be seen that a number of vessels were recorded at anchor approximately 2nm south of the ECR (within 2.5nm of the Tay Pilotage station).

One vessel was recorded at anchor within the cable route corridor, with two additional vessels anchoring within 1.4nm of the ECR. A summary of the vessels recorded at anchor within 1.4nm of the ECR during the survey period are provided below:

- A chemical/products tanker *Bro Goliath* (119m in length, broadcasting a draught of 6.5m) was recorded within the cable route corridor for four days (destination Dundee);
- The chemical/products tanker *Jette Theresa* (130m in length, broadcasting a draught of 6.1m) was recorded approximately 0.5nm south of the ECR for two days (destination Dundee); and
- The third closest vessel at anchor was the general cargo vessel *Crown Breeze* (89m in length, broadcasting a draught of 5.7m) recorded approximately 1.4nm south of the ECR for one day (destination Dundee).

A6. RECREATIONAL VESSEL ACTIVITY

6.1 Introduction

This section reviews recreational vessel activity relative to the ECR based on information published by the Royal Yachting Association (RYA) and the combined *EEMS* and *Highland Eagle* survey data.

6.2 RYA Data

6.2.1 Introduction

The RYA, supported by the Cruising Association (CA), have identified recreational cruising routes, general sailing and racing areas around the UK in the Coastal Atlas (Ref. i). This work was based on extensive consultation and qualitative data collection from RYA and CA members, through the organisations' specialist and regional committees and through the RYA affiliated clubs. The consultation was also sent to berth holder associations and marinas.

The reports note that recreational boating, both under sail and power is highly seasonal and highly diurnal. The division of recreational craft routes into Heavy, Medium and Light Use is therefore based on the following classification:

- *Heavy Recreational Routes*: - Very popular routes on which a minimum of six or more recreational vessels will probably be seen at all times during summer daylight hours. These also include the entrances to harbours, anchorages and places of refuge.
- *Medium Recreational Routes*: - Popular routes on which some recreational craft will be seen at most times during summer daylight hours.
- *Light Recreational Routes*: - Routes known to be in common use but which do not qualify for medium or heavy classification.

6.2.2 ECR Recreational Data

A chart of the recreational sailing activity and facilities relative to the ECR is presented in Figure 6.1.

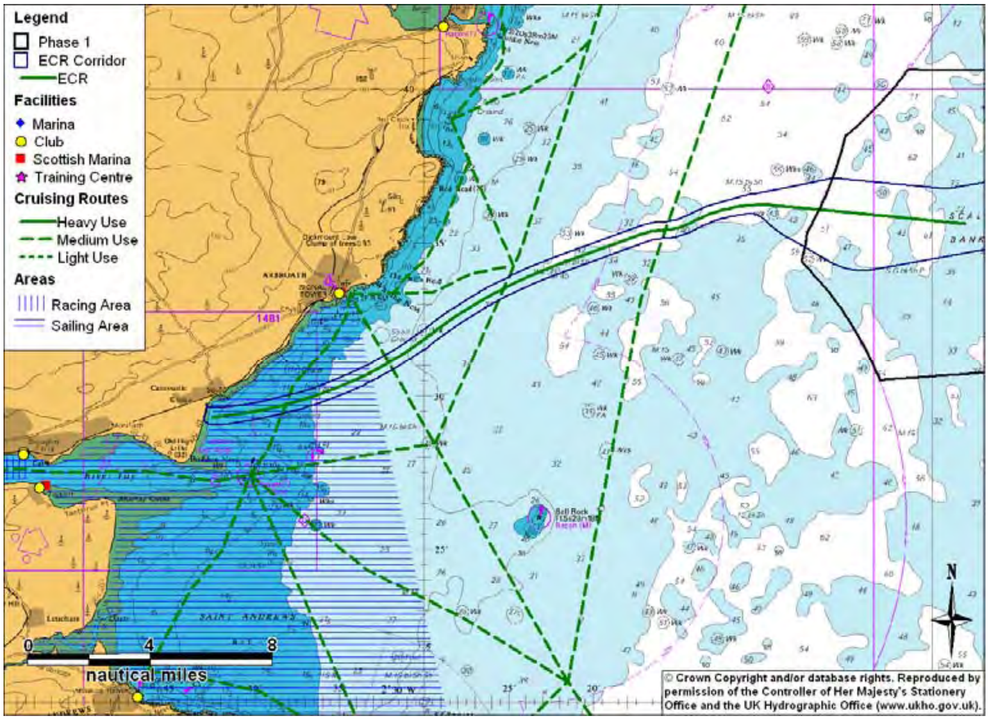

Figure 6.1 Recreational information for ECR

Based on the RYA published data, the ECR is intersected by four medium use cruising routes, two of which are headed between north eastern Scotland (Stonehaven/Peterhead) and the Firth of Tay and Firth of Forth and two of which are headed to/from Arbroath.

There is a sailing and boating club at Arbroath which hold a number of events and races during the summer.

The ECR intersects a 'general sailing' area within approximately 3nm of the coast. General sailing areas are defined by RYA as an area in extensive use for general day-sailing by all types of recreational craft but particularly smaller craft, including:

- small cruisers;
- day-boats;
- dinghies;
- sailboards; and
- personal watercraft.

Such craft will not normally be undertaking point-to-point passages but will be on out and return activities and may appear to be sailing in random directions as they take advantage of wind and tide to make progress.

6.3 Survey Data

No recreational vessels were recorded within 10nm of the ECR during the *EEMS* winter survey, therefore Figure 6.2 presents the recreation vessel tracks from the *Highland Eagle* survey only (June/July 2011).

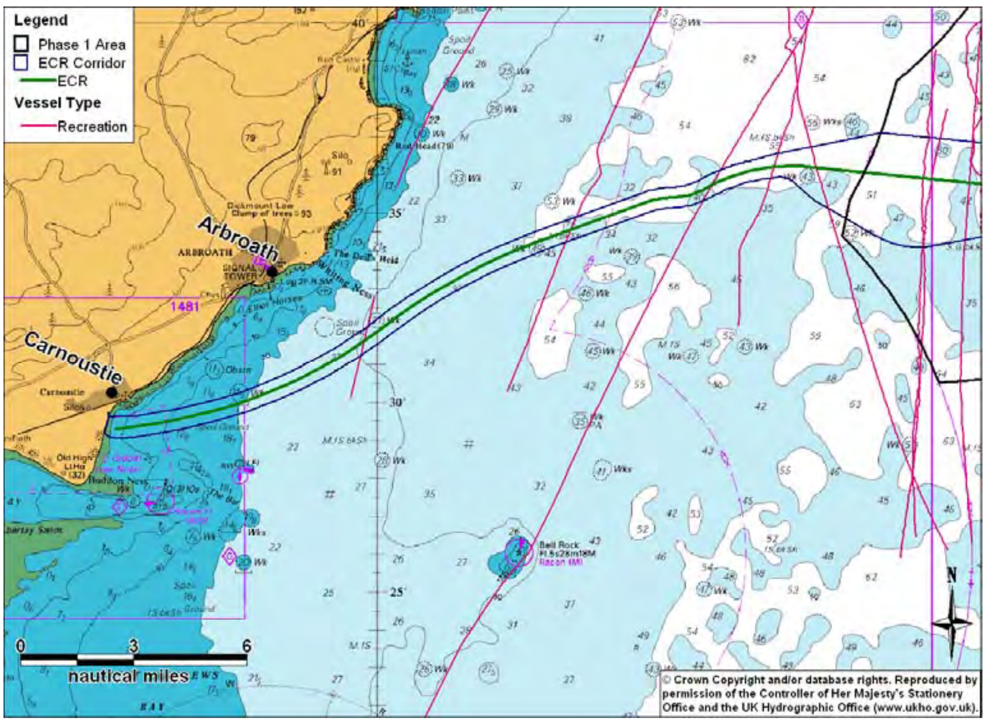

Figure 6.2 Recreation Vessels relative to the ECR recorded during *Highland Eagle* Survey (26 days)

It can be observed that a number of recreation sailing vessels were recorded intersecting the ECR, with a lower number of recreational tracks nearer to coastal areas when compared to near the zone.

It is noted that recreational activity in vicinity of the ECR is likely to be under-estimated due to the limits of radar tracking range onboard the survey vessels at this range. In addition, recreational vessels do not mandatorily carry AIS.

A7. FISHING VESSEL ACTIVITY

7.1 Introduction

This section reviews the fishing vessel activity relative to the ECR based on survey data, sightings and satellite data.

7.2 Survey Data

Figure 7.1 and Figure 7.2 present the fishing vessel tracks recorded during the vessel based surveys and coastal based survey relative to the ECR.

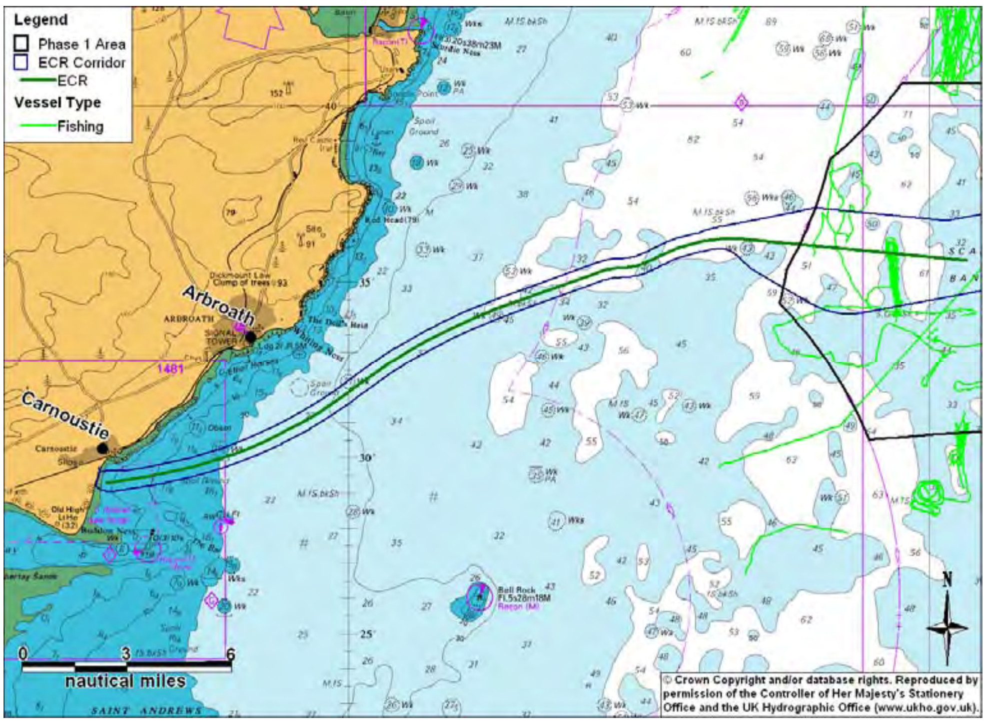

Figure 7.1 Fishing Vessels Relative to the ECR Recorded During Combined Survey (40 days)

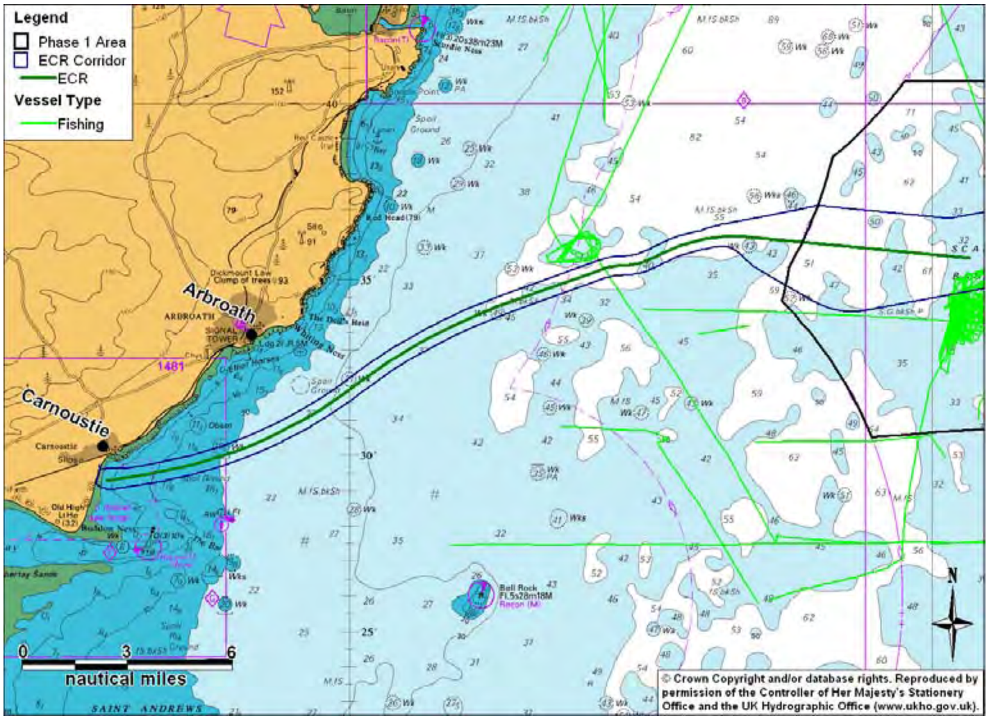

Figure 7.2 Fishing Vessels Relative to the ECR Recorded During Coastal Survey (56 days)

It can be observed that a low number of fishing vessels were recorded intersecting the ECR. In general, there were a greater number of fishing vessels in the area around Phase 1 compared to the ECR.

It is noted however that fishing activity in the ECR corridor could be slightly under-estimated in the survey vessel data due to the limits of radar tracking range onboard the survey vessels and the fact that fishing vessels under 45m did not mandatorily carry AIS at the time of the survey.

7.3 Sightings and Satellite Data Overview

7.3.1 Sightings Data

Data on fishing vessel sightings were obtained from the Marine Management Organisation (MMO). The Sea Fisheries Inspectorate (SFI) monitor the fishing industry's compliance with UK, EU and international fisheries laws through the deployment of patrol vessels, surveillance aircraft and the sea fisheries inspectorate.

Each patrol logs the positions and details of all fishing vessels (UK and non-UK) within the area being patrolled. All vessels are logged, irrespective of size, provided they can be identified by their Port Letter Number (PLN).

Data was obtained for the five-year period from 2005 to 2009. Section 7.4 presents the sightings data analysis.

7.3.2 Satellite Data

The Marine Management Organisation (MMO), formerly the Marine and Fisheries Agency, operates a satellite vessel monitoring system from its Fisheries Monitoring Centre in London. The vessel monitoring system is used, as part of the sea fisheries enforcement programme, to track the positions of fishing vessels in UK waters. It is also used to track all UK registered fishing vessels globally.

Vessel position reports are received approximately every two hours unless a vessel has a terminal on board which cannot be polled and then it must report once per hour. The data covers all EC countries within British Fisheries Limits and certain Third Countries, e.g., Norway and Faeroes. Vessels used exclusively for aquaculture and operating exclusively within baselines are exempt.

Satellite monitoring data from 2009 was analysed (including UK and non-UK fishing vessels). Section 7.5 presents the satellite data analysis.

7.4 Sightings Data Analysis

7.4.1 Sightings Density Grid

Figure 7.3 presents a density grid based on the 2005-2009 sightings data to highlight the hot spots of fishing vessel activity. It can be seen that there was generally a higher density of fishing activity on the eastern part of the ECR, when compared to the western part.

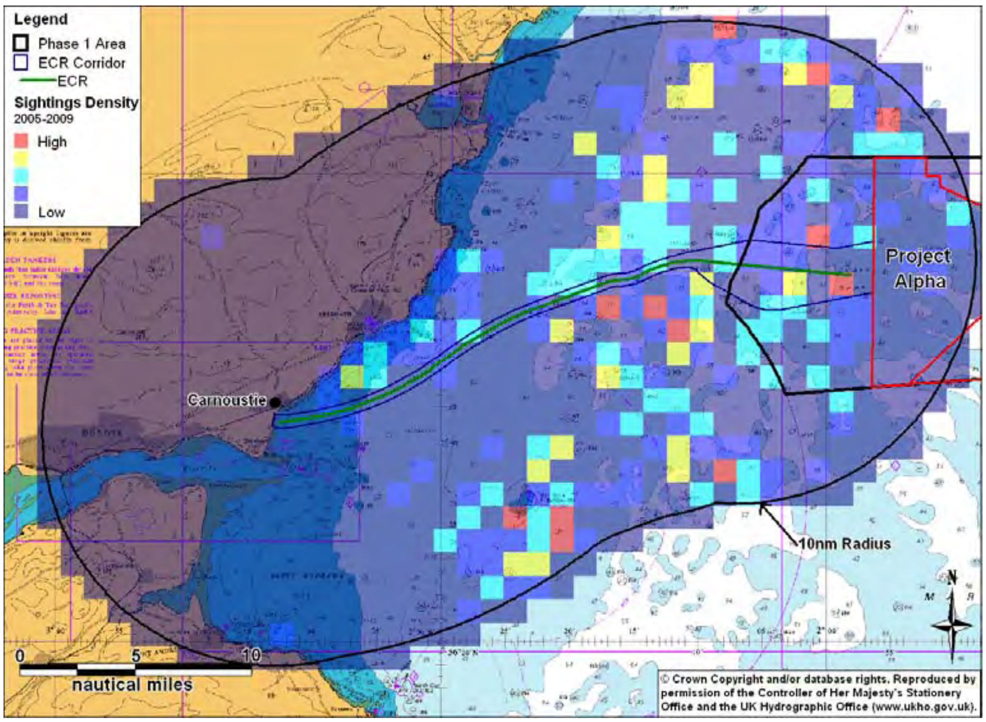

Figure 7.3 ECR Fishing Vessel Sightings Data (2005-2009)

7.4.2 Sightings Nationality Analysis

Over 99% of fishing vessel sightings within 10nm of the ECR were UK-registered, with one record of a fishing vessel registered in the Netherlands.

7.4.3 Sightings Gear Analysis

Using the fishing vessel sightings data, Figure 7.4 presents an analysis of the gear types used by vessels within 10nm of the ECR. It can be seen that the main fishing methods were scallop dredging (39%), potting (35%) and demersal stern trawling (21%), with around 3% of sightings being unspecified in terms of gear type.

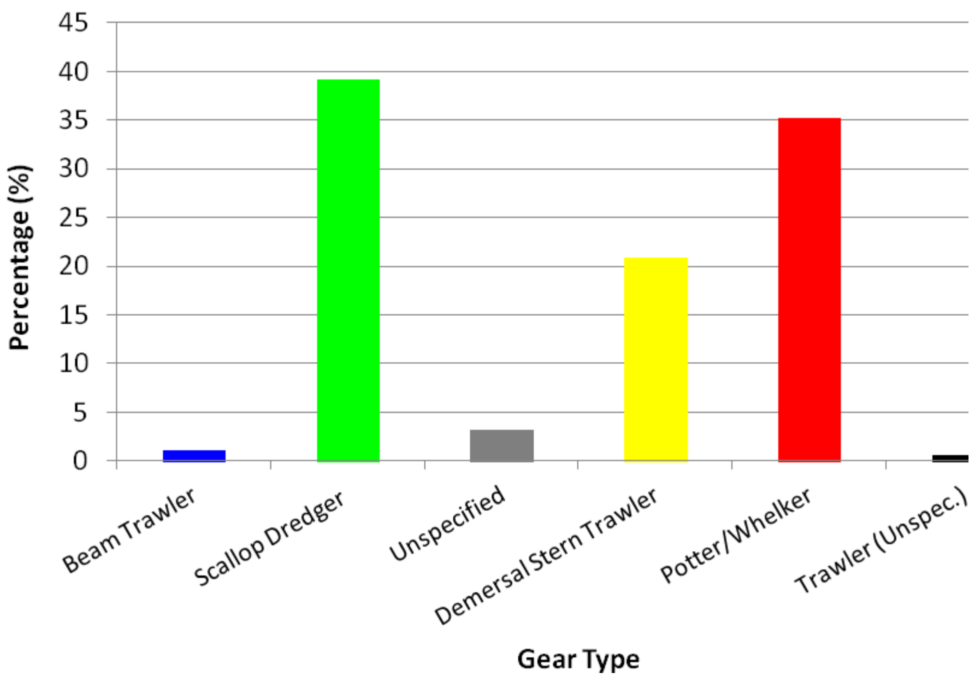

Figure 7.4 Fishing Vessels by Gear Type within 10nm of ECR (2005-2009)

7.4.4 Sightings Activity Analysis

From Figure 7.5, it can be seen that 85% of fishing vessels within 10nm of the ECR were engaged in fishing, 7% were steaming (transiting to/from fishing grounds) and 1% were laid stationary (vessels at anchor or pair vessels whose partner vessel is taking the catch whilst the other stands by).

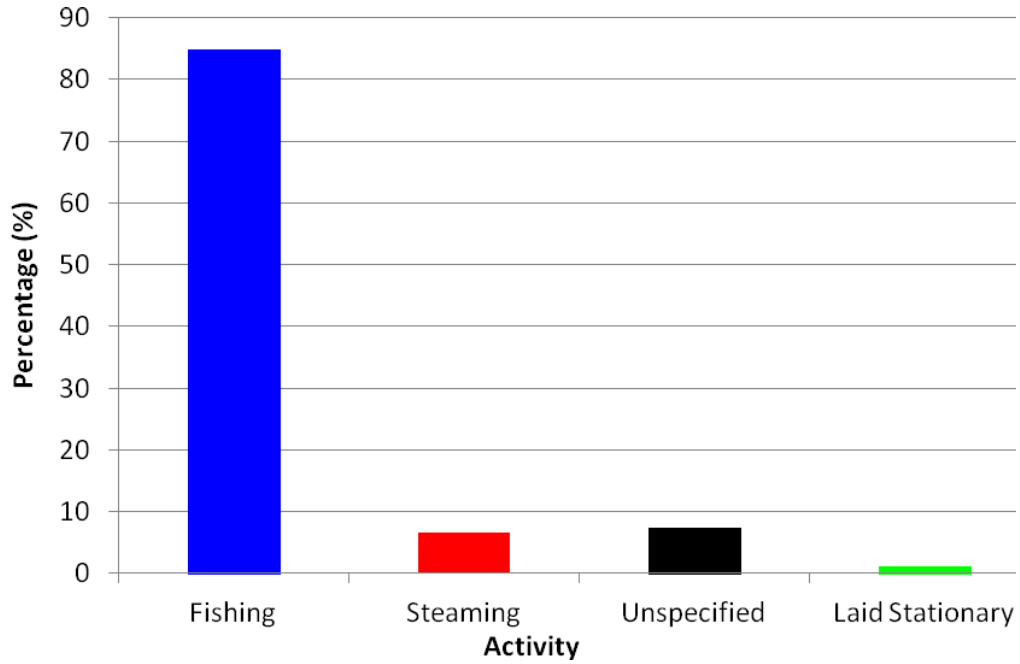

Figure 7.5 Fishing Vessels by Activity within 10nm of ECR (2005-2009)

7.5 Satellite Data Analysis

7.5.1 Satellite Density Grid

Figure 7.6 presents a density grid based on the 2009 satellite data to highlight the hot spots of fishing vessel activity. As was the case with the sightings data, a higher density of fishing activity can be observed on the eastern part of ECR, when compared to the western part.

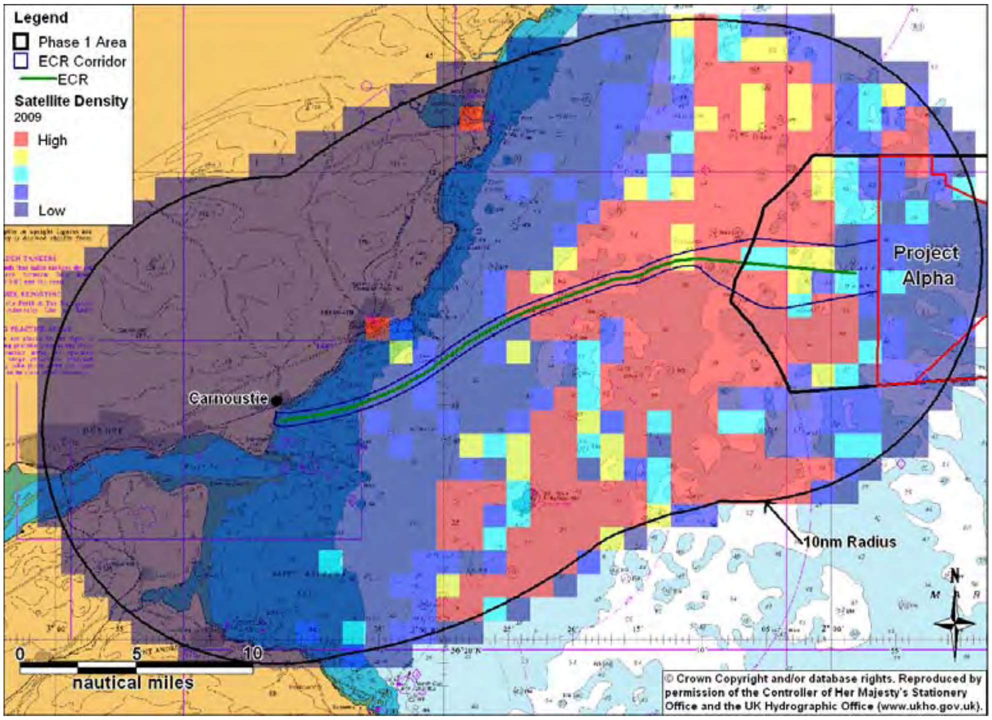

Figure 7.6 ECR Fishing Vessel Satellite Data (2009)

7.5.2 Satellite Nationality Analysis

The vast majority of vessels were UK-registered in the 2009 satellite data, with vessels from France and The Netherlands also being noted.

7.5.3 Satellite Gear Analysis

Figure 7.7 presents the vessel types (where available) for fishing vessel satellite positions recorded in 2009 within 10nm of ECR. 58% of vessels could not be specified. The majority of vessels which could be specified were either scallop dredgers (38%) or demersal stern trawlers (4%).

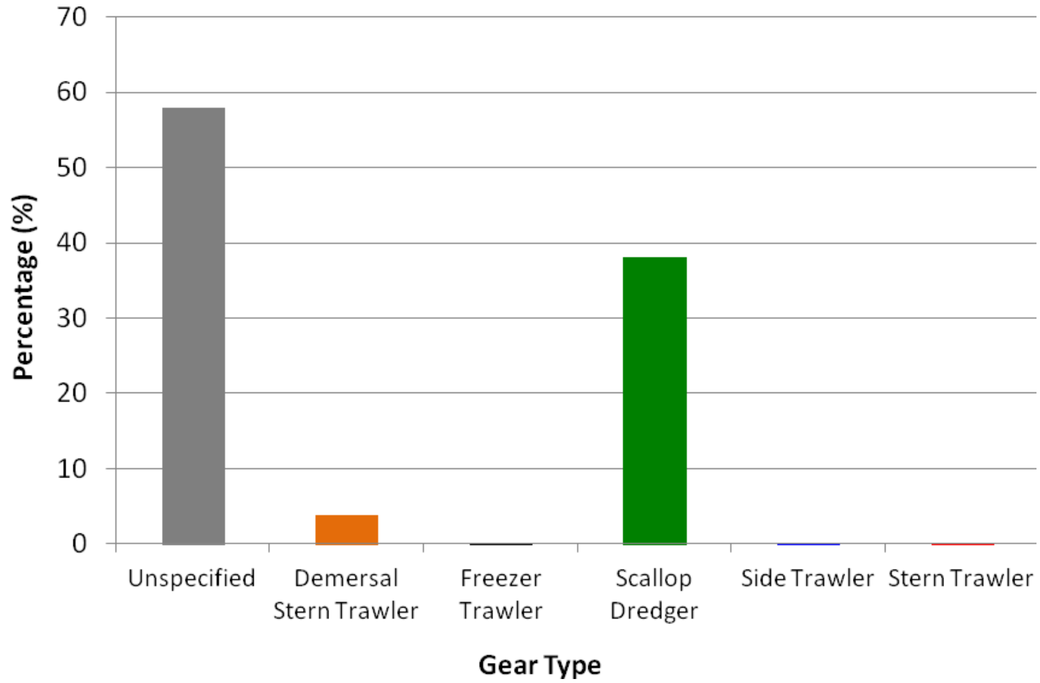

Figure 7.7 Fishing Vessels by Gear Type within 10nm of ECR (2009)

A8. RISKS TO CABLE

8.1 Introduction

This section describes the main hazards which could pose a risk to the ECR. The following hazards are described in detail:

- Fishing Gear Interaction
- Vessel Foundering
- Anchoring

8.2 Fishing Gear Interaction

The fishing types considered to pose the most risk to a subsea cable are bottom trawling (on the seabed) and scallop dredging, both of which are frequently carried out in the vicinity of the ECR. These fishing methods differ from mid water trawling (pelagic) where the net is towed higher in the water column and poses minimal risk of interaction with a subsea cable. A description of bottom trawling methods (otter trawling and beam trawling) and scallop dredging are provided in Sections 8.2.1 to 8.2.3.

8.2.1 Otter Trawl

This is the most commonly used towed gear in UK fisheries. Both finfish and shellfish found on or near the bottom are taken by this method.

The gear consists of a cone shaped net attached to the vessel by wire ropes or 'warps'. The length of the warp is normally about three and a half to four times the depth of the water and can be used in depths of 100-450m from the stern of the vessel. As the net is towed over the sea floor the mouth is kept open by large rectangular otter boards composed of timber or steel. The tail end of the net where the fish are trapped is the 'cod end'. The otter boards scrape the seabed as they are towed behind the vessel, thus creating a cloud of seabed material and creating the potential for interactions with subsea cables and pipelines. The main components of an otter trawl that have the potential to hook a subsea cable are the trawl doors and the clump weight. Figure 8.1 presents a schematic of a typical bottom otter trawler and Figure 8.2 presents a schematic of a twin demersal otter trawler.

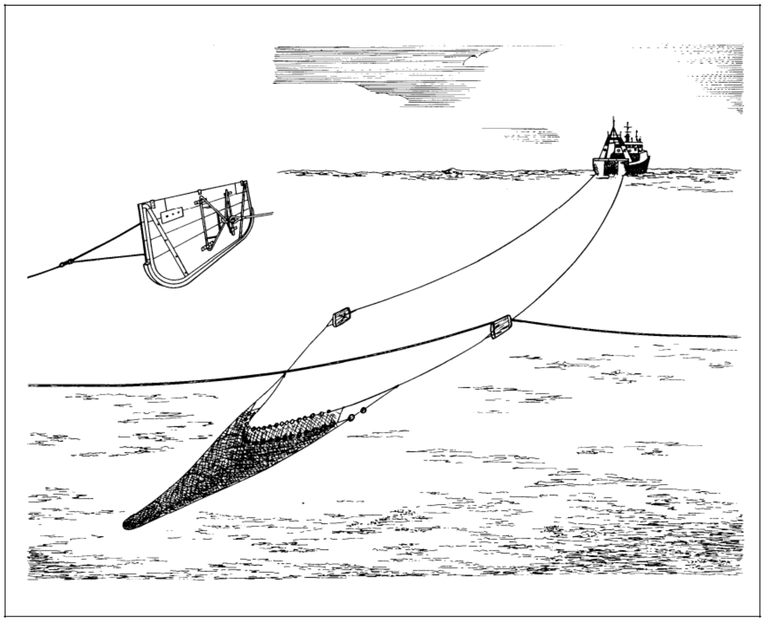

Figure 8.1 Example of Bottom (Otter) Trawl Catching a Cable (Ref. iii)

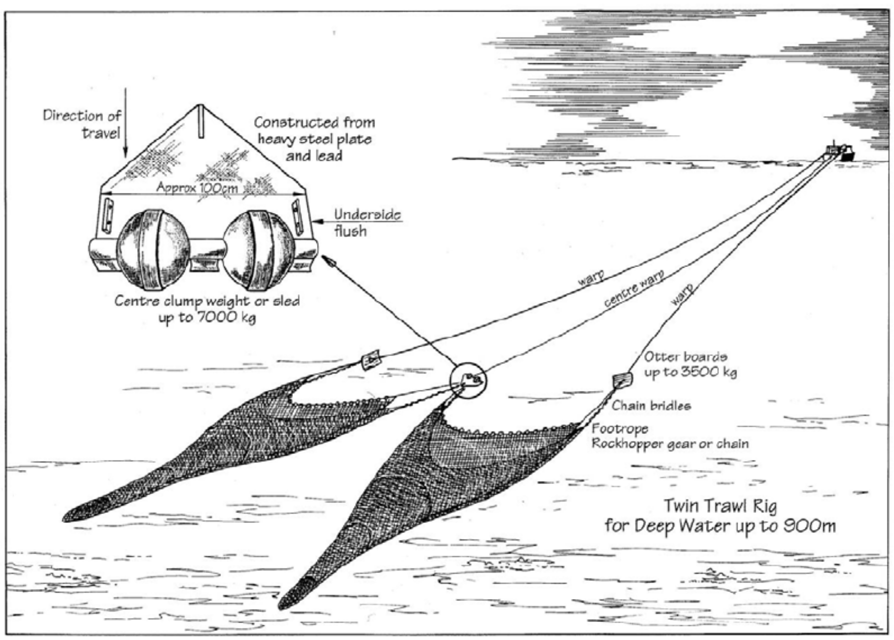

Figure 8.2 Twin Demersal Otter Trawl (Ref. iii)

8.2.2 Beam Trawl

The beam trawl is a bottom fishing trawl net, used mainly by small vessels for catching demersal flatfish relatively close to the shore. In beam trawling, the net is held open by a rigid beam which is attached to the netting. The net is heavily weighted with a chain on the underside and has tickler chains running in front. As was described with otter trawling, the seabed is disturbed by this fishing activity which creates the potential for cable and pipeline interactions. The main components of a beam trawl that have the potential to hook a pipeline are the beam and runners/shoes. A schematic of a typical beam trawler is presented in Figure 8.3 below.

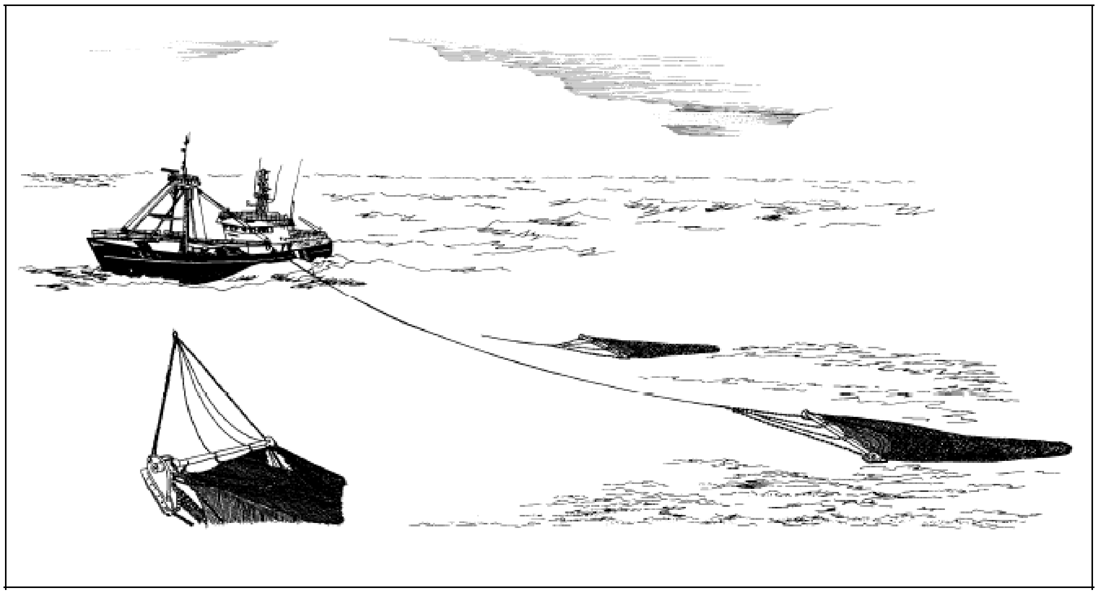

Figure 8.3 Beam Trawler (Ref. iii)

The main components of a Beam Trawl that have the potential to hook a pipeline are the beam and runners/shoes.

8.2.3 Scallop Dredger

Most scallop dredgers have a chain bag which drags along the bottom collecting the catch. Some also use steel teeth which penetrate the seabed by a few centimeters. Like other gear types, greater seabed penetration can occur under unusual conditions, such as when a dredge pushes a rock ahead of it. A dredge 4.5m wide with tickler chains can weigh in excess of 2,200kg when empty. With towing speeds ranging up to five knots, this type of gear can easily damage a submarine cable. In some fisheries, deflecting bars and wheels have been added to help the gear pass over seabed obstacles. Such devices may also help prevent entanglement with cables. An example of a typical scallop dredger is presented in Figure 8.4.

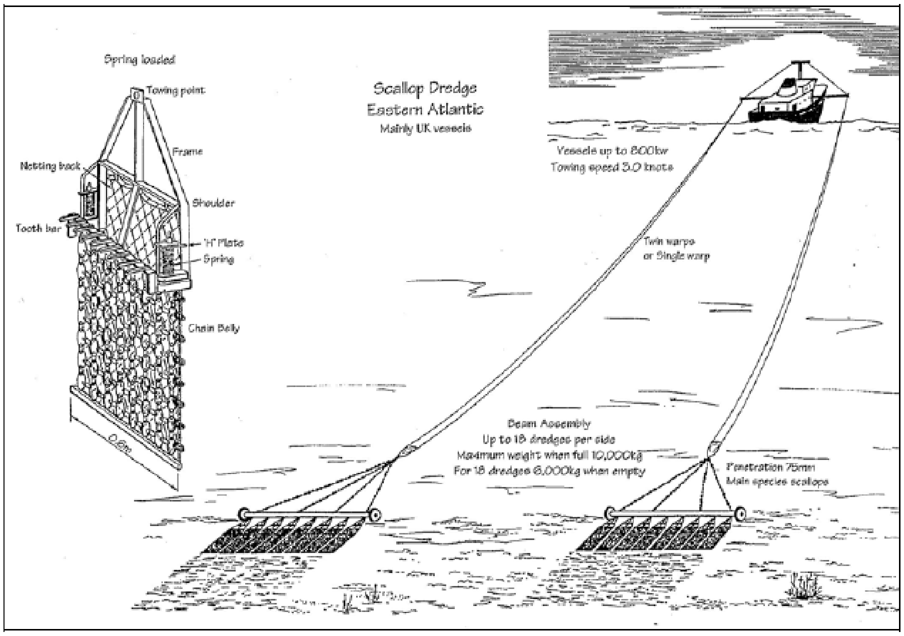

Figure 8.4 Plan View of Scallop Dredger (Ref. iii)

8.2.4 Gear Interaction with Cables

When trawl gear is towed over or along a cable, the interaction can be considered in three phases at described below.

- Impact:
    - The initial phase when the trawl board, beam shoe or clump weight hits the cable. This impact occurs over a short time frame and mainly results in localised damage to the shell and protective coating of the cable. This stage has the potential to damage the cables but rarely damages the trawl gear and there is negligible risk to the fishermen on board the vessel.

- Pull over:
    - This occurs when a trawl board, beam trawl or clump weight is pulled over the cable. The duration of this phase is longer than that of the initial impact and forces can be significantly greater. Again the risks to fishermen during this phase of the interaction are limited.

- Hooking:
    - Hooking occurs when the trawl equipment becomes "stuck" under the cable. This tends to be a low probability event but it represents the greatest risk to fishermen.

8.3 Vessel Foundering

A foundering is considered to be when a vessel suffers structural failure and sinks. This type of incident has the potential to damage a subsea cable if the vessel sinks over the cable. It is noted that this type of incident is considered to have a very low frequency based on historical incident data for the UK (from 1994-2008 approximately 4% of all MAIB incident types were listed as flooding/foundering).

8.4 Anchoring

Anchoring has the potential to damage a subsea cable if a vessel drops anchor on the cable or drags anchor over the cable. The damage caused depends on the penetration depth of the anchor (which depends on vessel size and type of anchor), the type of seabed and the cable burial depth. It is considered that anchor interaction with a subsea cable will be similar to that of fishing gear interaction, based on impact, pull over and potential snagging phases.

Anchoring can take place for a number of reasons. The following scenarios could lead to a vessel anchoring:

- Adverse weather anchoring (e.g. seeking refuge in a safe haven);
- Machinery failure (e.g. to slow drift speed/stop and/or to carry out repairs);
- Waiting on orders (e.g. commercial vessels and/or drilling rigs);
- Waiting on approach to a port (e.g. port berth or pilotage); and
- Subsea operations/survey vessel and semi-submersible drilling rig anchoring.

It is noted that when the cable is installed and charted, the probability of planned anchoring in close proximity to the cable route is reduced.

8.5 ECR Risk Assessment

A 1km x 1km grid consisting of 2764 cells was created for the area 10nm around the ECR.

Sections 8.5.1 to 8.5.3 present the methodology for ranking the abovementioned identified hazards (fishing gear interaction, vessel foundering and anchoring) with a value between 0 and 5 for each of the grid cells. The values for each of the three hazards were summed (maximum 15) and distributed into five sensitivity ranges. An overview chart showing the grid 10nm around the ECR, colour-coded by risk ranking, is presented in Figure 8.5.

8.5.1 Risk Ranking for Fishing Gear Interaction

Fishing vessel density per grid cell in the area 10nm around the ECR was categorised based on the satellite data (see section 7.5) which provided more comprehensive coverage of fishing vessel activity in the vicinity of the ECR compared to the sightings data and the survey data collected. It covers larger fishing vessels (15m+) which have the most potential to interact with subsea equipment.

Satellite tracking positions with speeds equal to or less than 5 knots were selected (it is assumed a vessel travelling over 5 knots will not be fishing) and grid cells were ranked from 0 (no activity) to 5 (highest activity).

8.5.2 Risk Ranking for Vessel Foundering

Combined AIS and Radar data from the *EEMS* and *Highland Eagle* surveys (40 days) and from the coastal surveys undertaken as part of the FTOWDG work (56 days) was used to identify cells with a higher density of shipping (which would therefore have a higher risk of foundering). Any cells where there number of vessel intersects was greater than 1 per day were given a ranking of 1.

In addition to this, the last ten years of RNLI and MAIB incident data (2001-2010) was analysed to extract incidents where a vessel foundered or was lost. For the areas where one of these incidents was recorded, a 500m radius was created around each incident (to take into account vessel break-up or drifting once submerged). Cells that were intersected by a foundering incident area were given the highest risk ranking (5).

8.5.3 Risk Ranking for Anchoring

Vessel anchoring was identified from the vessel based survey AIS data (40 days) (see Section 5.4) and from the coastal based survey AIS data (56 days) (see Section 5.6). Cells intersected by one anchored vessel were given a rank of 3 and cells intersected by two or more vessels and/or multiple days of anchoring were given a rank of 5.

Vessels that were involved in machinery or mechanical failure incidents can drop anchor to arrest or slow down their drift (when they are not under command). For this reason, incidents which recorded a machinery or mechanical failure were extracted from the RNLI and MAIB incident databases and given a ranking of 5.

Figure 8.5 below presents an overview of the cable risk ranking for 10nm around the ECR, based on the three rankings described above.

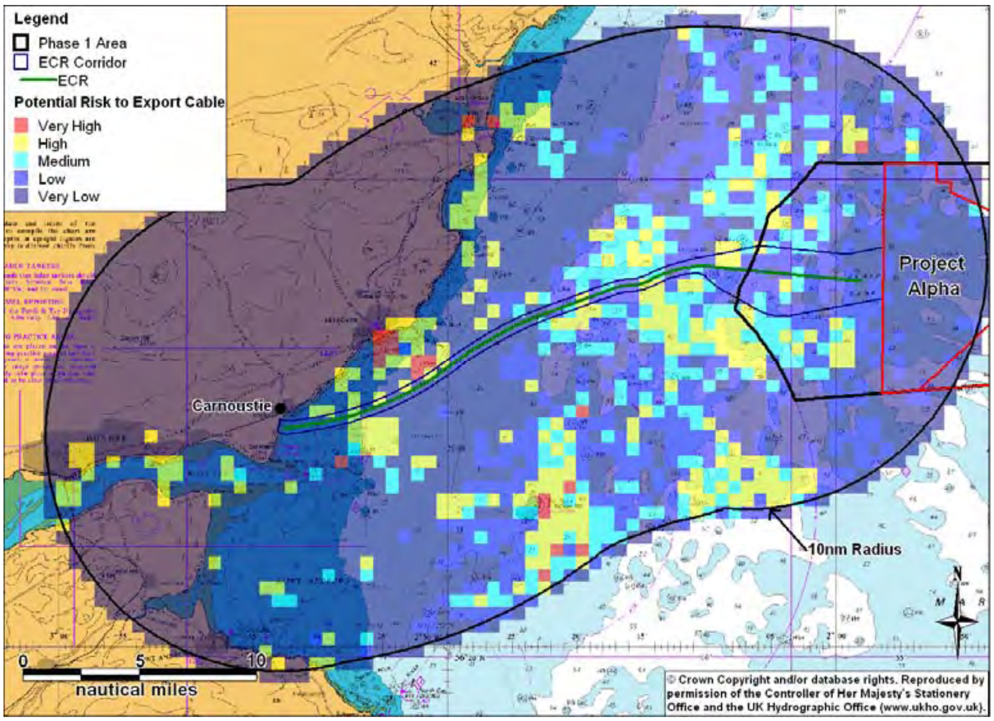

Figure 8.5 Overview of Cable Risk Ranking for 10nm around ECR

A number of high and very high risk areas were located within the 10nm buffer around the ECR. In terms of the export cable route itself, the only area where a very high risk was identified was approximately one third of the way along the cable route. This risk level can be attributed to the medium level of fishing recorded and the number of incidences recorded by the RNLI and MAIB which could have led to a vessel foundering on the export cable.

Medium and high risk areas were also identified further along the export cable route, between 6nm and 12nm east from the coast. This risk level is due to the density of fishing vessels recorded which could potentially be deploying gear that would lead to cable damage.

A9. EFFECT OF ECR ON SHIPPING AND NAVIGATION

9.1 Introduction

Following the baseline shipping and high level hazard review, the effects of the ECR are assessed below.

9.2 Commercial Shipping

The effects on commercial vessels from the ECR are assessed in the following subsections.

9.2.1 Effect on Commercial Vessel Routeing

A number of commercial shipping routes intersect the ECR with defined traffic routes being identified as heading south out of Montrose, north out of Tay ports and north out of Forth ports.

Traffic headed to and from Montrose crosses the cable route approximately 7nm from the coast. The majority of vessels recorded using this route are cargo vessels, tankers and offshore vessels headed to various ports south of Montrose such as Immingham (UK) and Brunsbuttel (Germany).

There is a lower use route recorded approximately 6nm along the cable route comprised of vessels headed out of Dundee to ports in Northern Scotland and Northern Europe. As was the case with traffic headed from Montrose, the majority of vessels on this route are cargo vessels, tankers and offshore vessels. Of all the main routes identified, this route passes closest to the coast but vessels generally stay well clear of the inshore shallower areas unless they are seeking an anchorage (see Section 3.3 for a detailed description of anchorage areas). The avoidance of inshore shallower waters reduces the risk of a vessel grounding or foundering on the export cable.

Another main route which crosses the ECR does so at the western boundary of Phase 1. Traffic on this route is mainly headed between Forth ports and ports to the north, including Aberdeen, Inverness, Kirkwall and Peterhead. The main vessel types using this route are tankers, cargo vessels and offshore support vessels, with a number of passenger vessels from the port of Leith also being recorded.

In terms of the effect on commercial shipping routes, vessels on the main routes described above will be displaced during cable installation and maintenance activities. However, given the low traffic levels and available sea room for vessel deviations along with the temporary nature of the work and the limited geographical area which will be affected at any one time, the overall effect on commercial shipping will be small.

9.2.2 Effect on Anchoring Vessels

There are a number of designated and recommended anchorages in proximity to the ECR (these are described in detail in Section 3.3). Based on the data collected in the maritime traffic surveys, vessels were recorded at anchor within the ECR Corridor and at locations approximately 0.8nm south of the ECR (within 2nm of the Tay Pilotage station), within Saint Andrews Bay which is located 7.5nm to the south and within Lunan Bay which is approximately 5nm to the north. The closest vessel anchoring relative to the ECR was the offshore support vessel *Toisa Daring* (70m in length, broadcasting a draught of 5.8m) which was recorded anchored within the cable route corridor, with destination as Dundee.

It is expected that following installation of the export cable and marking on Admiralty Charts, anchoring activity close to the cable is likely to migrate, as vessels become aware of the subsea cables. The presence of designated anchorages with good holding ground means that a proportion of vessels are likely to anchor in these areas instead.

This effect will last for the entire duration of the wind farm operation whilst export cables are in place and may continue post-decommissioning if cables are not removed.

9.3 Effect on Fishing Vessels

In terms of fishing gear interaction, demersal trawlers and scallop dredgers were amongst the most abundant vessel types noted in the sightings and satellite data recorded within 10nm of the ECR. As described in detail in Sections 8.2.2 and 8.2.3, both of these fishing methods have the potential to cause damage to cables due to the gear interaction with the seabed. If fishing gear was to interact with the cable then there is the potential for entanglement which could lead to damage to the cable, the gear and the fishing vessel.

This risk will be reduced with the introduction of mitigation measures to reduce the exposure of the cable. Cable protection and burial techniques will reduce the effect on fishing vessels, as well as providing protection and stabilisation to the cable. At the Navigational Hazard Review Workshop, carried out in January 2012 as part of the NRA process for the Firth of Forth zone, there was a general consensus that fishing operators would object to unprotected surface laid cables. It was also noted that concrete mattresses pose a risk to fishing vessels because, if gear was to snag a concrete mattress then the vessel could be toppled in extreme cases. Rock dumping is considered to be less of a risk for gear snagging, especially when smaller rock pieces (typically 3-5 inches) are used. Surveying and monitoring of the seabed to monitor burial depths and sea bed mobility, as well as consultation with fisheries stakeholders should also be implemented to ensure this impact is kept at a low level.

9.4 Effect on Recreation Vessels

The ECR is intersected by four medium-use cruising routes. The two routes which are closest to the shore are headed to/from Arbroath where there is an established Sailing and Boating Club and a marina with 53 berths and 6 visitor berths available. The two routes which are further from the shore are headed between north east Scotland (Stonehaven/Aberdeen/Peterhead) to the Firth of Tay/Firth of Forth. In addition to this, a number of recreational vessels were recorded sailing in a direction parallel to the coastline during the survey and therefore crossing the ECR.

The greatest risk to recreation vessels will be during cable laying and maintenance activities because the increased number of vessels working on site will consequently increase the vessel to vessel collision risk. It is assumed that recreational users will be provided with information through Notices to Mariners and liaison with local clubs and marinas regarding the installation activities. Overall, only a small effect is predicted on recreation vessels, given the available sea room in the area to deviate around installation vessels.

9.5 Electromagnetic Interference on Vessel Navigation Equipment

An additional navigational impact was identified based on electromagnetic interference on small vessels' (mainly recreational craft and small fishing boats) navigation equipment including compasses and communication equipment.

The ECR is proposed to be High Voltage Direct Current (HVDC), given the ability to transmit large amounts of power over long distances with lower costs and reduced power losses compared to Alternating Current (AC). HVDC export cables could cause deflection of a compass needle through electromagnetic interference. The amount of deflection depends on the magnitude of the electric current and the angle the cable makes with the magnetic meridian. Some vessels with an autopilot dependent upon a magnetic sensor may experience steering difficulties crossing the cable.

However, based on the findings of trials at the North Hoyle Offshore Wind Farm (Ref. iv), the wind turbines and their cabling (both inter-array and export) did not cause any compass deviation during the trials. Studies have also found that the greater distance the compass is from the cause of interference the less impact will be experienced.

In addition the export cables will be buried (where seabed conditions permit) and buried and any generated electromagnetic fields will be very weak and have a minimal effect on navigation or electronic equipment.

A10. RISK MITIGATION AND MONITORING

10.1 Introduction

This section summarises the main mitigation measures and monitoring procedures which could be established for the ECR.

10.2 Mitigation

The following risk mitigation measures can be used to protect subsea cables from hostile interactions such as anchoring and fishing gear interactions:

- Burying/trenching cables where seabed conditions permit to reduce the risk of snagging or anchor interaction;
- Use of rock dumping to protect cables or to limit the height of free spans;
- Use of concrete mattresses to protect cables;
- Routeing cables away from fishing grounds where possible;
- Routeing cables on stable and even ground to limit free spans;
- Circulating information on cables to the fishing community, e.g. fishing liaison and FISHSAFE via Kingfisher Information Services-Cable Awareness (KIS-CA). Positions of cable routes should be provided to KIS-CA for inclusion in cable awareness charts and plotters for the fishing industry;
- Vessels setting up anchoring alarm zones to warn if an anchor has moved (dragged);
- Promulgation of information and warnings through appropriate media to other marine stakeholders, e.g. local ports, recreation sailing clubs, ship operators and the Defence Infrastructure Organisation (DIO);
- Export cable routes are charted on United Kingdom Hydrographic Office (UKHO) admiralty charts and potential no anchorage zones are shown over cables. Note that, depending on the scale of the chart, all submarine cables may not be charted and it may only be the export cables which are shown;
- Monitoring of the cable route from Marine Operations/Coordination Centre with an alarm system set up when vessels show reduced speeds in proximity to the cable route; and
- Periodic and planned inspections and surveys of cable routes to monitor burial depths and sea bed mobility to ensure the cables remain buried and do not become a hazard to marine navigation. This should include ad hoc inspections after potential anchor interactions.

The following mitigation measures should be considered during cable laying activities and any future maintenance work on the cable route:

- Promulgation of Information (including Notices to Mariners (NtMs) and Very High Frequency (VHF) broadcasts);
- Use of guard vessels;
- Rolling safety zones; and

- Temporary aids to navigation including buoyage in line with NLB requirement.

Workshops on shipping and navigation issues have taken place to discuss local issues. Consultation should also continue both pre- and post-construction and during the life of the project with the MCA and other relevant stakeholders such as Forth Ports Ltd.

A11. CONCLUSIONS

Following a baseline review of shipping and navigation in the vicinity of the ECR, the hazards were assessed.

By analysing the AIS data collected from the vessel based survey (40 days in March 2011 and June/July 2011) and the coastal based survey (56 days in June 2010 and November 2010), vessel routes were identified as intersecting the ECR.

There are charted anchorages at Lunan Bay, off Buddon Ness and in St Andrews Bay. Vessels were recorded at anchor in the vicinity of the ECR, with the closest anchoring incident being within the export cable corridor. It is expected that anchoring activity close to the cable will migrate away from the cable in order to avoid potential interactions, including to the designated anchorages in the vicinity.

There is a risk to fishing vessels and to the export cable due to gear snagging on unprotected cables, as demersal trawling and scallop dredging were both recorded in the vicinity of the ECR. Suitable mitigation would include cable protection/burial, monitoring of cable burial depths and liaison with the fishing industry.

Given the potential for anchor and fishing gear interactions with the export cable, an anchor penetration study and Burial Protection Index (BPI) assessment should be carried out to further assess cable protection methods. This will help ensure the effects on anchoring and fishing vessels are minimised.

The main risk to recreation vessels will be during cable laying and maintenance activities due to the increased number of vessels working on site. However, with suitable mitigations in place the effect is considered to be small.

The electromagnetic fields generated by the HVDC export cables are likely to be very weak and the effect on navigation or electronic equipment is not considered to be significant.

A12. REFERENCES

i RYA, 2008. UK Coastal Atlas.

ii Admiralty Sailing Directions – North Sea (West) Pilot, NP 54, 8th Edition, 2009.

iii International Cable Protection committee, 2009. Fishing and Submarine Cables, Working Together, Second Edition – Catch Fish, not cables! Stephen C. Drew and Alan G. Hopper, February 2009.

iv QinetiQ and MCA, 2004. Results of the EM Investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle Wind Farm, 29 September 2004.

MCA MGN 371 Checklist

Phase 1

(Appendix B)

Prepared by:	Anatec Limited
Presented to:	Seagreen
Date:	5th July 2012
Revision No.:	00
Ref.:	A2520-SEA-NRA-1 App B

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TABLE OF CONTENTS

B1. Introduction

This Appendix presents the Marine Coastguard Agency (MCA) checklist based on the requirements set out in Marine Guidance Note (MGN) 371 which was the guidance set by the MCA during the NRA preparation.

Reference notes/remarks are made within the table based on which sections of the Navigational Risk Assessment (NRA), or other documents, address the issue noted in the MGN 371 checklist.

B2. MGN 371 Compliance Checklist

Table 1 MGN 371 Compliance Checklist for the Proposed East Anglia ONE Windfarm

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
Considerations on Site Position, Structures and Safety Zones			
1. Traffic Survey			
All vessel types	✔		Section 8 of NRA.
Four weeks duration, within 12 months prior to submission of the Environmental Statement	✔		Survey period comprised 40 days AIS/Radar survey from March 2011 to July 2011.
Seasonal variations	✔		Surveys have been carried out in winter (March 2011) and summer (June and July 2011).
Recreational and fishing vessel organisations	✔		Sections 11 and 12 of NRA.
Port and navigation authorities	✔		Sections 6, 9 and 10 of NRA.
Assessment			
Proposed OREI site relative to areas used by any type of marine craft.	✔		Sections 8-12 of NRA.
Numbers, types and sizes of vessels presently using such areas	✔		Sections 8-12 of NRA.
Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, etc.	✔		Sections 8-12 of NRA.
Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✔		Section 8 of NRA.
Alignment and proximity of the site relative to adjacent shipping lanes	✔		Sections 8-10 of NRA.
Whether the nearby area contains prescribed routeing schemes or precautionary areas	✔		Not applicable.
Whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes	✔		Not applicable.
Proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas.	✔		Sections 6 and 8 of NRA.
Whether the site lies within the limits of jurisdiction of a port and/or navigation authority.	✔		Section 6 of NRA.
Proximity of the site to existing fishing grounds, or to routes used by fishing	✔		Section 12 of NRA and Commercial Fisheries Assessment.

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
vessels to such grounds.			
Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✔		Section 6.6 of NRA.
Proximity of the site to existing or proposed offshore oil / gas platform, marine aggregate dredging, or other exploration/exploitation sites	✔		Section 6.5 and 18 of NRA.
Proximity of the site relative to any designated areas for the disposal of dredging spoil	✔		Not applicable.
Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon.	✔		Sections 6 of NRA.
Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density.	✔		Sections 8, 9-10 and 14-15 of NRA.
Type(s) of simulation used in analysis Limitation of system (s)	✔		Sections 8, 9-10 and 14-15 of NRA.
2. OREI Structures			
Whether any features of the OREI, including auxiliary platforms outside the main generator site and cabling to the shore, could pose any type of difficulty or danger to vessels underway, performing normal operations, or anchoring	✔		Sections 8-17 of NRA.
Clearances of wind turbine blades above the sea surface *not less than 22 metres*	✔		Section 3.4 of NRA.
Least depth of current turbine blades	✔		Not applicable.
The burial depth of cabling	✔		0.5m to 3m.
Whether any feature of the installation could create problems for emergency rescue services, including the use of lifeboats, helicopters and emergency towing vessels (ETVs)	✔		Section 20 of NRA.
How rotor blade rotation and power transmission, etc., will be controlled by the designated services when this is required in an emergency.	✔		Section 20 of NRA.
3. Assessment of Access to and Navigation Within, or Close to , an OREI To determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:			

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
a. Navigation within the site would be safe:	✔		
i. by all vessels, or ii. by specified vessel types, operations and/or sizes. iii. in all directions or areas, or iv. in specified directions or areas. v. in specified tidal, weather or other conditions			Entire NRA.
b. Navigation in and/or near the site should be:	✔		
i. prohibited by specified vessels types, operations and/or sizes. ii. prohibited in respect of specific activities, iii. prohibited in all areas or directions, or iv. prohibited in specified areas or directions, or v. prohibited in specified tidal or weather conditions, or simply vi. recommended to be avoided.			Entire NRA.
c. Exclusion from the site could cause navigational, safety or routeing problems for vessels operating in the area.	✔		See Sections 8-12 for discussion of likely impacts of site on vessel activity.
Relevant information concerning a decision to seek a "safety zone" for a particular site during any point in its construction, operation or decommissioning.	✔		Section 19 of NRA.
Navigation, collision avoidance and communications			
1. The Effect of Tides and Tidal Streams : It should be determined whether or not:			
Current maritime traffic flows and operations in the general area are affected	✔		Sections 3, 6, 8 and 21 of NRA

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa.			
Set and rate of the tidal stream, at any state of the tide, has a significant affect on vessels in the area of the OREI site.	✔		Sections 6, 7, 8 14,15 and 21 of NRA
Maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect.	✔		Section 6.7 of NRA.
The set is across the major axis of the layout at any time, and, if so, at what rate.	✔		Section 6.7 of NRA.
In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream.	✔		Section 6.7, 14.3 and 15.3 of NRA. (Tides in the area used to model risk of drifting ship collision.)
Structures themselves could cause changes in the set and rate of the tidal stream.	✔		Section 21.3 of NRA.
Structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the windfarm area or adjacent to the area	✔		Section 21.5 of NRA.
2. Weather: To determine if:			
The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it.	✔		Sections 3, 6.7, 7-15, 17, 21 and 22 of NRA.
The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✔		Section 21.4 of NRA.
In general taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set.	✔		Sections 14.3 and 15.3 of NRA (Drifting collision risk model).
3. Visual Navigation and Collision Avoidance: To assess the extent to which			
Structures could block or hinder the view of other vessels under way on any route.	✔		Section 21.2 of NRA.
Structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories, etc	✔		Section 21.2 of NRA.

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
4. Communications, Radar and Positioning Systems : To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether or not:			
Structures could produce radio interference such as shadowing, reflections or phase changes, with respect to any frequencies used for marine positioning, navigation or communications, including Automatic Identification Systems (AIS), whether ship borne, ashore or fitted to any of the proposed structures.	✔		Section 21.8 of NRA.
Structures could produce radar reflections, blind spots, shadow areas or other adverse effects: a. Vessel to vessel; b. Vessel to shore; c. VTS radar to vessel; d. Racon to/from vessel.	✔		Section 17 of NRA.
OREI, in general, would comply with current recommendations concerning electromagnetic interference.	✔		Section 17 of NRA.
Structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✔		Section 21.6 of NRA.
Site might produce acoustic noise which could mask prescribed sound signals.	✔		Section 21.9 of NRA.
Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.	✔		Section 21.7 of NRA.
5. Marine Navigational Marking : To determine:			
How the overall site would be marked by day and by night taking into account that there may be an ongoing requirement for marking on completion of decommissioning, depending on individual circumstances.	✔		Section 4 of NRA.
How individual structures on the perimeter of and within the site, both above and below the sea surface, would be marked by day and by night.	✔		Section 4 of NRA.
If the specific OREI structure would be inherently radar conspicuous from all	✔		Section 4 of NRA.

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
seawards directions (and for SAR and maritime surveillance aviation purposes) or would require passive enhancers			
If the site would be marked by one or more racons and/ or,	✔		Section 4 of NRA.
If the site would be marked by an Automatic Identification System (AIS) transceiver, and if so, the data it would transmit.	✔		Section 22 of NRA. (under consideration)
If the site would be fitted with a sound signal, and where the signal or signals would be sited	✔		Not applicable.
If the structure (s) would be fitted with aviation marks, and if so, how these would be screened from mariners or potential confusion with other navigational marks & lights resolved.	✔		Section 4 of NRA
Whether the proposed site and/or its individual generators would comply in general with markings for such structures, as required by the relevant General Lighthouse Authority (GLA) or recommended by the Maritime and Coastguard Agency, respectively.	✔		Section 4 of NRA.
The aids to navigation specified by the GLAs are being maintained such that the 'availability criteria', as laid down and applied by the GLAs, is met at all times.	✔		Section 4 of NRA.
The procedures that need to be put in place to respond to casualties to the aids to navigation specified by the GLAs, within the timescales laid down and specified by the GLAs.	✔		Section 4 of NRA.
Safety and mitigation measures recommended for OREI during construction, operation and decommissioning.			
Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the Environmental Impact Assessment (EIA).The specific measures to be employed will be selected in consultation with the Maritime and Coastguard Agency and will be listed in the developer's Environmental Statement (ES). These will be consistent with international standards contained in, for example, the	✔		Sections 20 and 22 of NRA.

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
Safety of Life at Sea (SOLAS) Convention - Chapter V, IMO Resolution A.572 (14)[3] and Resolution A.671(16)[4] and could include any or all of the following:			
Promulgation of information and warnings through notices to mariners and other appropriate media.	✔		Sections 20 and 22 of NRA.
Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).	✔		Sections 20 and 22 of NRA.
Safety zones of appropriate configuration, extent and application to specified vessels	✔		Section 19 of NRA.
Designation of the site as an area to be avoided (ATBA).	✔		Not applicable.
Implementation of routeing measures within or near to the development.	✔		Not applicable. (See Sections 9 and 10 for Impact on Commercial Shipping Navigation).
Monitoring by radar, AIS and/or closed circuit television (CCTV).	✔		Sections 20 and 22 of NRA.
Appropriate means to notify and provide evidence of the infringement of safety zones or ATBA's.	✔		Sections 19, 20 and 22 of NRA.
Any other measures and procedures considered appropriate in consultation with other stakeholders.	✔		Sections 20 and 22 of NRA.
Standards and procedures for wind turbine generator shutdown in the event of a search and rescue, counter pollution or salvage incident in or around a wind farm. The wind farm should be designed and constructed to satisfy the following design requirements for emergency rotor shut-down in the event of a search and rescue (SAR), counter pollution or salvage operation in or around a wind farm:			
All wind turbine generators (WTGs) will be marked with clearly visible unique identification characters which can be seen by both vessels at sea level and aircraft (helicopters and fixed wing) from above.	✔		Sections 4 and 20 of NRA.
The identification characters shall each be illuminated by a low intensity light visible from a vessel this enabling the structure to be detected at a suitable distance to avoid a collision with it. The size of the identification characters in combination with the lighting should be such that, under normal conditions of visibility and all known tidal conditions, they are clearly readable by an observer, stationed 3 metres above sea levels, and at a distance of at least 150 metres from the turbine. It is recommended that lighting for this purpose be hooded or	✔		Sections 4 and 20 of NRA

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
baffled so as to avoid unnecessary light pollution or confusion with navigation marks. (Precise dimensions to be determined by the height of lights and necessary range of visibility of the identification numbers).			
For aviation purposes, OREI structures should be marked with hazard warning lighting in accordance with CAA guidance and also with unique identification numbers (with illumination controlled from the site control centre and activated as required) on the upper works of the OREI structure so that aircraft can identify each installation from a height of 500ft (150 metres) above the highest part of the OREI structure.	✔		Sections 4 and 20 of NRA.
Wind Turbine Generators (WTG) shall have high contrast markings (dots or stripes) placed at 10 metre intervals on both sides of the blades to provide SAR helicopter pilots with a hover reference point.	✔		Section 20 of NRA.
All WTGs should be equipped with control mechanisms that can be operated from the Central Control Room of the wind farm or through a single contact point.	✔		Section 20 of NRA.
Throughout the design process for a wind farm, appropriate assessments and methods for safe shutdown should be established and agreed, through consultation with MCA and other emergency support services.	✔		Sections 20 and 22 of NRA.
The WTG control mechanisms should allow the Control Room Operator to fix and maintain the position of the WTG blades as determined by the Maritime Rescue Co-ordination Centre or Maritime Rescue Sub Centre (MRCC/SC).	✔		Sections 20 and 22 of NRA.
Nacelle hatches should be capable of being opened from the outside. This will allow rescuers (e.g. helicopter winch-man) to gain access to the tower if tower occupants are unable to assist and when sea-borne approach is not possible.	✔		Sections 20 and 22 of NRA.
Access ladders, although designed for entry by trained personnel using specialised equipment and procedures for turbine maintenance in calm weather, could conceivably be used, in an emergency situation, to provide refuge on the turbine structure for distressed mariners. This	✔		Sections 14 and 15 of NRA.

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
scenario should therefore be considered when identifying the optimum position of such ladders and take into account the prevailing wind, wave and tidal conditions.			
Although it may not be feasible for mariners in emergency situations to be able to use wave or tidal generators as places of refuge, consideration should nevertheless be given to the provision of appropriate facilities.	✔		Section 20 of NRA
2. Operational Requirements			
The Central Control Room, or mutually agreed single point of contact, should be manned 24 hours a day.	✔		Sections 20 and 22 of NRA.
The Central Control Room operator, or mutually agreed single point of contact, should have a chart indicating the Global Positioning System (GPS) position and unique identification numbers of each of the WTGs in the wind farm.	✔		Sections 20 and 22 of NRA.
All MRCCs/MRSCs will be advised of the contact telephone number of the Central Control Room, or mutually agreed central point of conatct.	✔		Sections 20 and 22 of NRA.
All MRCCs/MRSCs will have a chart indicating the GPS position and unique identification number of each of the WTGs in all wind farms.	✔		Sections 20 and 22 of NRA.
3. Operational Procedures			
Upon receiving a distress call or other emergency alert from a vessel which is concerned about a possible collision with a WTG or is already close to or within the wind farm, or when the MRCC/MRSC receives a report that persons are in actual or possible danger in or near a wind farm and search and rescue aircraft and/or rescue boats or craft are required to operate over or within the wind farm, the MRCC/MRSC will establish the position of the vessel and the identification numbers of any WTGs which are visible to the vessel. This information will be passed immediately to the Central Control Room, or single	✔		Sections 20 and 22 of NRA.

MGN 371 COMPLIANCE			
Issue	**Yes**	**No**	**Remarks**
contact point, by the MRCC/MRSC. A similar procedure will be followed when vessels are close to or within other types of OREI site			
The control room operator should immediately initiate the shut-down procedure for those WTGs as requested by the MRCC/MRSC, and maintain the WTG in the appropriate shut-down position, again as requested by the MRCC/MRSC, or as agreed with MCA Navigation Safety Branch or Search and Rescue Branch for that particular installation, until receiving notification from the MRCC/MRSC that it is safe to restart the WTG.	✔		Sections 20 and 22 of NRA.
The appropriate procedure to be followed in respect of other OREI types, designs and configurations will be determined by these MCA branches on a case by case basis, in consultation with appropriate stakeholders, during the Scoping and Environmental Impact Assessment processes.	✔		Section 21of NRA
Communication and shutdown procedures should be tested satisfactorily at least twice a year. Shutdown and other procedures should be tested as and when mutually agreed with the MCA.	✔		Sections 20 and 22 of NRA.

Hazard Workshop Report

Phase 1

(Appendix C)

Prepared by:	Anatec Limited
On behalf of:	Seagreen
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TABLE OF CONTENTS

C1. Introduction

This appendix presents the Hazard Log for the navigational risks associated with the proposed Phase 1 offshore wind farms (Project Alpha and Project Bravo) and the Transmission Asset Project in the outer approaches to the Firth of Forth and Tay off the east coast of Scotland.

The workshop was held in Dunfermline on 18th January 2012 attended by local maritime stakeholders, as outlined in Table 1. Other marine stakeholders including representatives from the Chamber of Shipping, Cruising Association, Scottish Canoe Association, RNLI and regular operators were also invited but could not be present on the day.

Table 1 Hazard Review Workshop Attendees

Attendee	Position	Company/Organisation
Peter Douglas	Navigation Manager	Northern Lighthouse Board (NLB)
Archie Johnstone	Navigation Officer	Northern Lighthouse Board (NLB)
Pete Thomson	Offshore Energy Liaison Officer	Maritime and Coastguard Agency (MCA)
Scott Horsburgh	Marine Superintendent	Marine Scotland
Archie MacCallum	Commanding Officer, *MPV Hirta*	Marine Scotland
Bill Hughes	Manager of Fisherman's Mutual Association (FMA) (Pittenweem) Ltd	Kingdom Seafood/FMA Ltd
Sandy Ritchie	Secretary	Anglo-Scottish Fisherman's Federation
John Watt	Fishing Industry Advisor	Scottish Fisherman's Federation
Ashley Nicholson	Assistant Marine Manager	Forth Ports Plc.
Leanne Fisher	Marine Officer	Forth Ports Plc.
Graham Russell	Planning and Environment Officer	Royal Yachting Association (Scotland)
Robert Waterston	Interim Project Developer for Seagreen Wind Energy	URS Infrastructure & Environment UK Limited
Naomi Healey-Cathcart	Project Manager Offshore Development	Seagreen Wind Energy Ltd
Mike Cain	Senior Risk Analyst	Anatec Ltd

Attendee	Position	Company/Organisation
Robert Jones	Risk Analyst	Anatec Ltd

The approach taken in this assessment is in line with the "*Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms*" produced by The Department of Energy and Climate Change (DECC), in association with the Marine Coastguard Agency (MCA) and the Department for Transport (DfT). This provides a template for developers in preparing their navigation risk assessments. The methodology is centred on risk controls and the feedback from risk controls into risk assessment. It requires a submission that shows sufficient risk controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with further controls or actions.

The key maritime hazards associated with the wind farm development were identified and associated scenarios prioritised by risk level. Within each scenario, vessel types were considered separately to ensure the risk levels were assessed for each and the control options were identified on a type-specific basis, e.g., risk control measures for fishing vessels differ to those for commercial ships.

The ranking of the risks associated with the various hazards was carried out following the workshop based on the discussions at the workshop, using a risk matrix with the frequency and consequence categories shown below.

Other general hazards associated with the construction, decommissioning and maintenance phases, such as dropped object and man overboard, were also identified for the site but were not discussed in detail.

C2. Hazard Log Methodology

The hazards were recorded systematically using Anatec's Hazard Management software. The main information logged by the system is presented in Table 2.

Table 2 Hazard Log Field Description

Category	Definition
Hazard ID	Unique Hazard Identification number generated by the software.
Title	Title of hazardous event.
Date Recorded	Date the hazard was logged in the system.
Responsible Person	Person with responsibility to manage the hazard.
Review Period	Minimum time period that hazard should be reviewed.
Event Description	Description of the hazardous event.
Category	General hazard category, e.g., General Navigational Safety.
Sub-Category	Hazard sub-category, e.g., collision.
Area	Location of Hazardous event, e.g., Inside or Outside of wind farm
Phase	Phase(s) of operation e.g. Pre-Installation, Construction, Operation, Maintenance and Decommissioning. (Can be more than one.)
Causes	List all the potential causes of the hazard.
Probable Outcome Description	Description of the probable (or most likely) outcome should the hazard occur.
Worst Credible Outcome Description	Description of the 'worst credible' outcome should the hazard occur.
Frequency (Probable Outcome)	Estimates the frequency of the probable outcome occurring.
Frequency (Worst Credible Outcome)	Estimates the frequency of the worst credible event occurring.
Consequence (Probable Outcome)	Estimates the probable outcome should the event occur in terms of consequence to People, Environment, Asset, Business and overall average.
Consequence (Worst Credible Outcome)	Estimates the worst credible outcome should the event occur in terms of consequence to People, Environment, Asset, Business and overall average.
Risk Estimate (Probable Outcome)	Combines the frequency and (average) consequence to estimate the risk level for probable event.
Risk Estimate (Worst Credible Outcome)	Combines the frequency and (average) consequence to estimate risk level for the worst credible event.

Category	Definition
Risk Reduction Measures	Documents the potential mitigation measures which will aid in the reduction of risk or in the management of the hazardous event.

The following frequency and consequence categories were applied.

Table 3 Frequency Bands

Rank	Description	Definition
1	Negligible	< 1 occurrence per 10,000 years
2	Extremely Unlikely	1 per 100 to 10,000 years
3	Remote	1 per 10 to 100 years
4	Reasonably Probable	1 per 1 to 10 years
5	Frequent	Yearly

The consequence bands (Table 4) estimate the result, (should the event occur) in terms of probable and worst case outcomes to people, property, the environment and business.

The environmental ranking is based on the International Petroleum Industry Environmental Conservation Association (IPIECA) concept of a tiered preparedness and response arrangement as summarised below:

- **Tier 1** spills are generally small, causing localised damage, usually near the company's own facilities. In most cases, this type of spill occurs as a result of the company's own activities;
- A **Tier 2** spill is larger than a Tier 1 spill, but is still one that occurs in the area of the producing company's facilities. Tier 2 spills usually require the aid of other companies and resources, including the government. (It is noted that in terms of the consequence bands the difference between a Rank 3 and Rank 4 is limited/local external assistance would be present for Rank 3 and regional assistance would be required for Rank 4); and
- **Tier 3** spills are the most severe; and cannot be contained with the resources of the producing company and require substantial external resources to deal with them.

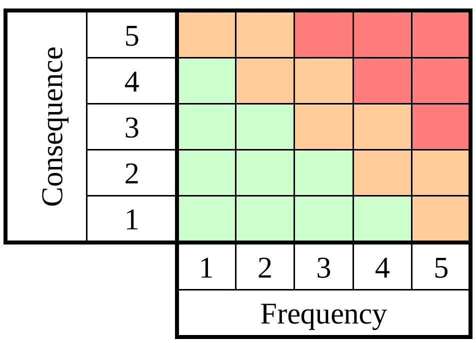
Table 4 Consequence Bands

Rank	Description	Definition			
		People	Property	Environment	Business
1	Negligible	No injury	<£10k	<£10k	<10k
2	Minor	Slight injury(s)	£10k-£100k	Tier 1 Local assistance required	£10k-£100k

Rank	Description	Definition			
		People	Property	Environment	Business
3	Moderate	Multiple moderate or single serious injury(s)	£100k-£1M	Tier 2 Limited external assistance required	£100k-£1M Local publicity
4	Serious	Multiple serious injury(s) or single fatality	£1M-£10M	Tier 2 Regional assistance required	£1M-£10M National publicity
5	Major	More than 1 fatality	>£10M	Tier 3 National assistance required	>£10M International publicity

The four consequence scores (on for each of 'people', 'property', 'environment' and 'business') were then averaged and multiplied by the frequency to obtain an overall ranking (or score) which determined the hazard's position within the risk matrix shown below in Table 5.

Table 5 Risk Matrix



where:

	Broadly Acceptable Region (Low Risk)	Generally regarded as insignificant and adequately controlled. None the less the law still requires further risk reductions if it is reasonably practicable. However, at these levels the opportunity for further risk reduction is much more limited.
	Tolerable Region (Intermediate Risk)	Typical of the risks from activities which people are prepared to tolerate to secure benefits. There is however an expectation that such risks are properly assessed, appropriate control measures are in place, residual risks are as low as is reasonably practicable (ALARP) and that risks are periodically reviewed to see if further controls are appropriate.
	Unacceptable Region (High Risk)	Generally regarded as unacceptable whatever the level of benefit associated with the activity.

As well as ranking the hazard by expected risk, based on the estimated frequency versus consequence, the worst case risk was also ranked in order to capture scenarios with a particularly high worst-case risk.

The worked example below illustrates the method of ranking hazards.

Hazard Title	Attendant vessel collision with wind farm structure.
Possible Causes	Poor visibility; Manoeuvring error; Machinery failure; Lack of passage planning; Lack of experience; Lack of awareness; Human error; Fatigue; Engine failure/ blackout; Bad weather.
Probable Consequence	Minor bump leading to minor damage to vessel and structure. Vessel most likely to be damaged.
Frequency of Probable Outcome	Reasonably probable (1 to 10 years) based on experience of attendant vessel collisions visiting offshore platforms.
Worst Credible Consequences	Moderate speed collision with significant damage to vessel, holed and vessel sinks, potential fatalities, damage to tower.
Frequency of Worst Credible Outcome	Extremely unlikely (100 to 10,000 years) in terms of significant consequences, i.e., loss of vessel with fatalities.

Table 6 presents the risk ranking of this hazard for the probable (most likely) outcome.

Table 6 Risk Matrix: Attendant Vessel Collision with Structure (Probable Outcome)

Consequence (People)					
5					
4					
3					
2				X	
1					
	1	2	3	4	5
	Frequency				

Consequence (Property)					
5					
4					
3					
2				X	
1					
	1	2	3	4	5
	Frequency				

Consequence (Environment)					
5					
4					
3					
2					
1				X	
	1	2	3	4	5
	Frequency				

Consequence (Business)					
5					
4					
3					
2				X	
1					
	1	2	3	4	5
	Frequency				

The risk for the hazard is calculated by averaging the four consequences, i.e., (2+2+1+2)/4 = 1.75) and multiplying by the frequency, i.e., 4, to obtain a risk ranking of 7 (i.e. 1.75 x 4). A score of 7 puts this hazard in the 'Tolerable' region.
The worst credible risk was also ranked using a similar methodology.

The potential mitigation measures for this event were logged as follows:

- Adverse weather working policy and procedures;
- Control of work procedures;
- Fenders/bumper bollards installed on turbines;
- Emergency Response Cooperation Plan;
- Marine Coordinator on site during works;
- Marine operating procedures;
- Marking and lighting;
- Passage plan to and from the site;
- Planning of major activities;
- Site personnel trained in fire fighting, first aid and offshore survival;
- Safety Management Systems for all vessels working in the site;
- Sharing of information within the industry.

C3. Results

The following list of hazards were reviewed, with the information recorded using Anatec's Hazard Log Software. It is noted that Hazard 3 and Hazard 5 were split up by vessel type following feedback received during the workshop.

1. Attendant vessel collision with wind farm structure

Support vessel collides with wind farm structure during construction or maintenance activities at the site.

2. Man overboard during work activities at site.

Man overboard during work activities at site.

3. Commercial vessel (powered) collision with wind farm structure

Commercial vessel, e.g. cargo vessel, ferry or tanker, collides with wind farm structure when under power (steaming).

4. Vessel anchoring on or dragging over subsea equipment

Vessels may anchor over a subsea cable/structure or a nearby vessel at anchor may drag its anchor over a subsea cable/structure. It is also possible that vessels anchor in an emergency and drop their anchor on a subsea cable/structure.

5. Vessel drifting collision with wind farm structure

Vessel Not Under Command (NUC) due to machinery failure and drifts, e.g. cargo vessel, ferry or tanker, drifting collision with wind farm structure (NUC).

6. Fishing gear interaction with inter-array cabling or other subsea structures

There is potential for fishing gear to interact with inter-array cables

7. Fishing vessel collision with wind farm structure and/or substations

Fishing vessel collides with wind farm structure whilst fishing in area or steaming in transit.

8. Recreational craft collision with wind farm structure

Recreational craft collide with wind farm structure.

9. Unauthorised mooring/boarding to structure and/or deliberate damage to device

Vessels moor to the structure without the authority to do so and/or with the intention to cause damage to the device.

10. Vessel-to-vessel collision due to avoidance of site or support vessels in area

Displaced traffic increases congestion outside of the site. This can lead to an increase in vessel-to-vessel encounters and ultimately collisions.

11. Dropped object during work activities at the site

Dropped object during construction and/or maintenance operations

12. Increased navigational risks during the construction and decommissioning
There could be an increased risk of vessels colliding with the turbines during construction due to lower levels of awareness and transient construction/decommissioning activities.

13. Fishing gear interaction with export cable
Fishing gear is dragged over an export cable.

14. Access to structure in an emergency situation
During emergency situations, a vessel may have to moor to a wind farm structure or a person in the water may seek a safe haven.

As noted above, based on stakeholder feedback received from the workshop held in Dunfermline, Hazard 3 (**Commercial vessel powered collision with wind farm structure**) and Hazard 5 (**Vessel drifting collision with wind farm structure**) were ranked post-workshop based on vessel type:

- Cargo vessel (powered and drifting [NUC] collision with wind farm structure)
- Tanker (powered and drifting [NUC] collision with wind farm structure)

The overall breakdown by tolerability region was assessed for the 16 hazards and is presented in Figure 1.

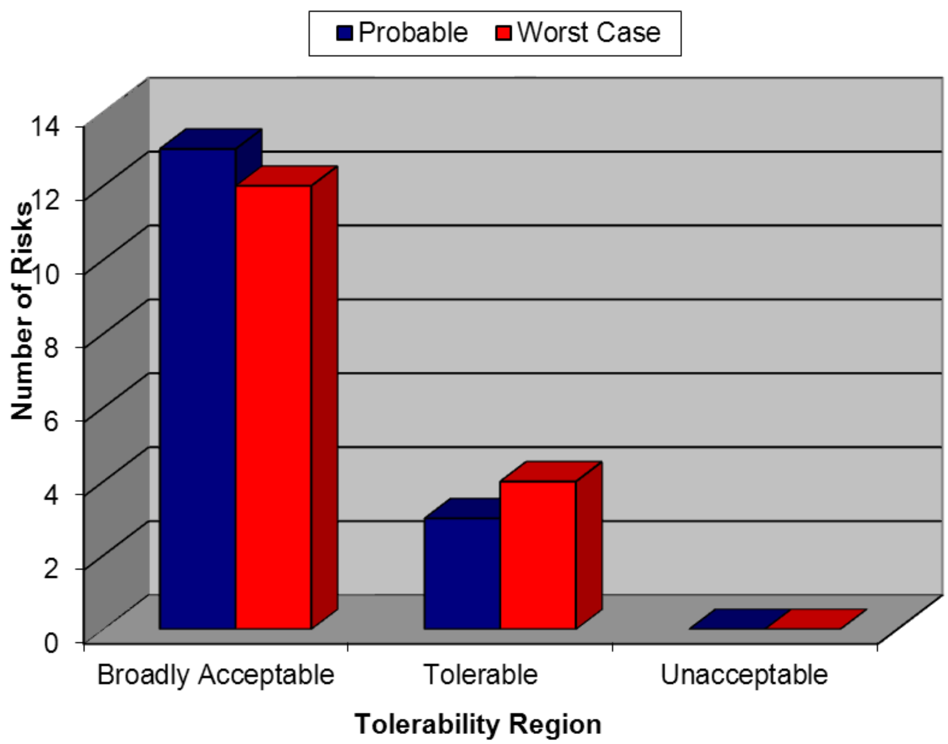


Figure 1 Phase 1 Risk Ranking Results

No risks were assessed to be unacceptable. As shown in Figure 1, three risks were ranked within the 'Tolerable' region based on the probable outcome whilst four were ranked as 'Tolerable' based on the worst case outcome.

The hazards ranked as tolerable based on probable outcome were:

- Attendant vessel collision with wind farm structure;
- Man overboard during transfer to/from turbine or working alongside turbine; and
- Tanker powered collision with turbines or offshore substation.

The hazard ranked as tolerable based on worst case outcome were:

- Attendant vessel collision with wind farm structure;
- Man overboard during transfer to/from turbine or working alongside turbine;
- Fishing gear interaction with inter-array cabling or subsea equipment; and
- Fishing vessel collision.

Several of the tolerable and worst case outcomes involve third party vessels, but these incidents have a lower likelihood of occurring. In addition, it is not known at this stage if there will be guard vessels used during the construction and decommissioning phases.

Full details of the logged and ranked hazards are summarised in Table 7, sorted by descending order of risk ranking (probable followed by worst credible outcome).

Table 7 Phase 1 Hazard Ranking Results

Phase	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Consequence	Worst Case Consequence	Most Likely						Risk Reduction	Worst Case						Notes
							Frequency	People	Environme	Property	Business	Risk		Frequency	People	Environme	Property	Business	Risk	
All	Navigation	Attendant vessel collision with wind farm structure	Vessels will be working in proximity to the wind farm structures, e.g., during construction and maintenance. Mis-judgement, weather conditions or equipment failure could lead to a collision due to limited time to take preventative action.	Lack of experience; Communication failure; DP failure; Engine Failure/ Blackout; Fatigue; Fouled propeller; Gear snagging; Bad weather; Installation not planned or carried out properly; Watchkeeper failure; Machinery Failure; Manoeuvring error; Marine coordinator; Navigational Aid Failure; Poor Visibility; Steering Gear Failure; Target not visible on radar; Human error.	Minor bump leading to minor damage to vessel and structure. Vessel most likely to be damaged.	Moderate speed collision with significant damage to vessel, holed and vessel sinks, potential fatalities, damage to turbine or substation structure.	4	2	1	2	2	7	Marking and Lighting; AIS fitted on all workboats working within site; AIS Transceiver; Compliance with Colregs; Continuous Watch by multi-channel VHF, including DSC; Control of Work Procedure; Emergency contact available 24hrs per day; Emergency Response Cooperation Plan; Emergency shutdown system; Exclusion zone during construction; Adverse weather working policy and procedures; Marine Operating Procedures; Tug Availability; Monitoring system; Passage plan to and from site; Personal Protective Equipments (PPE); Personnel Training; Pollution response plans; Position Monitoring; Procedures for all vessels working in the site; Safety Management System; Site personnel trained in fire fighting, first aid and offshore survival.; Marine Coordinator on site during works.	2	5	2	4	4	7.5	A multi-purpose vessel could provide emergency response functions at the wind farms
All	Marine Renewables	Man overboard during work activities at site	Man overboard during transfer to/from turbine or working alongside wind farm structure.	Structural Failure; Personal injury (slips, trips, falls, heart attack); Manoeuvring error; Lack of experience; Lack of awareness; Installation not planned or carried out properly; Human error; Fatigue; Engine Failure/ Blackout; Design Flaw; Communication failure; Bad weather.	Person in water recovered by transfer or support boat crew.	Loss of life. Person lost at sea.	4	3	1	1	2	7	VHF Carriage; Site personnel trained in fire fighting, first aid and offshore survival.; Safety Management System; Procedures for all vessels working in the site; Personnel Training; Personal Protective Equipments (PPE); Offshore Survival Training; Operation and/or Maintenance vessel intervenes; Marine Coordinator on site during works; Guard Vessel during Construction; Emergency Response Cooperation Plan; Control of Work Procedure; Continuous Watch by multi-channel VHF, including DSC; CDM Regulations; Adverse weather working policy and procedures.	3	4	1	1	4	7.5	
All	Marine Renewables	Tanker powered collision	Tanker powered collision with the turbines or offshore substation.	Manoeuvring error; Displacement of traffic; Failure to comply with Colregs; Fire/ Explosion; Human error; Lack of awareness; Lack of experience; Bad weather; Machinery Failure; Watchkeeper failure; Navigational Aid Failure; Personal injury (slips, trips, falls, heart attack); Poor Visibility; Radar interference; Steering Gear Failure; Structural Failure; Vessels attracted to site - curiosity; Lack of Passage Planning.	Glancing blow off turbine or substation structure, significant damage to structure and damage to the vessels hull. Serious impact on the environment due to potential for pollution from the tanker.	Turbine or substation structure collapse, vessel holed and sinks, potential fatalities and major pollution.	2	3	4	3	4	7	Website showing sea obstructions by region; Safety Zone; Promulgation of information to local users; Passage Planning by Shipping; Notice to Mariners; Navigational information broadcasts; Monitoring system; MGN 372; Marking and Lighting; Marine Coordinator on site during works; Guard Vessel during Construction; Exclusion zone during construction; Compliance with Colregs; Chart Markings.	1	5	5	5	5	5	Closed Circuit Television (CCTV) cameras were proposed on the turbines (at different points) and there is the potential for radar monitoring. This could be monitored from both shore and offshore, (e.g. on a mothership or on substations).
All	Navigation	Anchor on or dragging over subsea equipment	Vessel drops anchor over subsea equipment or a nearby vessel drags anchor over a subsea cable. Vessel may drop anchor over cable(s) in an emergency, i.e. machinery failure when changing over engines when approaching port.	Watchkeeper failure; Vessels attracted to site - curiosity; Uncharted obstruction on seabed; Poor Holding Ground; Manoeuvring error; Machinery Failure; Lack of experience; Lack of awareness; Installation not planned or carried out properly; Human error; Engine Failure/ Blackout; Dragged anchor; Cable becomes exposed (unprotected cable); Bad weather.	Damage to cable(s).	Serious damage to cable(s), loss of anchor, major business interruption.	3	2	1	3	3	6.8	Tug Availability; Position Monitoring; Monitoring system; Marking and Lighting; Marine Coordinator on site during works; Chart Markings; Cable protection, e.g., burial; Adverse weather working policy and procedures; Abandon gear.	2	2	2	5	4	6.5	Tugs are available within the Firth of Forth. The export cable will be trenched and possibly buried / raised above the sea bed if the cable cannot be protected in the sediment. Rock dumping could also be used to protect the export cable.
All	Marine Renewables	Tanker drifting collision	Tanker looses power and drifts into turbines/substations.	Structural Failure; Steering Gear Failure; Poor Holding Ground; Machinery Failure; Lack of Passage Planning; Human error; Fouled propeller; Fire/ Explosion; Engine Failure/ Blackout; Dragged anchor; DP failure.	Glancing blow off turbine or substation structure, significant damage to offshore structure and damage to the hull of the tanker. Serious impact on the environment due to pollution from the tanker.	Significant damage, potential collapse of wind farm structure. Likely to be significant damage to the ships hull, serious injuries to crew and major pollution.	2	2	4	3	4	6.5	Tug Availability; Operation and/or Maintenance vessel intervenes; Monitoring system; Marine Coordinator on site during works; Emergency Response Cooperation Plan; Anchoring by drifting vessel.	1	4	5	5	5	4.8	Tugs are available within the Firth of Forth.

Phase	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Consequence	Vorst Case Consequence	Frequency	People	Environment	Property	Business	Risk	Risk Reduction	Frequency	People	Environment	Property	Business	Risk	Notes
All	Navigation	Fishing gear interaction with inter-array cabling or subsea equipment	Fishing vessel gear is snagged on subsea equipment or J-tube.	Uncharted obstruction on seabed; Steering Gear Failure; Navigational Aid Failure; Lack of experience; Lack of awareness; Installation not planned or carried out properly; Human error; Gear snagging; Fishing vessels attracted to site; Cable becomes exposed (unprotected cable).	Loss of fishing gear, minimal damage to subsea equipment.	Fishing vessel capsizes with loss of life, loss of vessel and pollution.	3	3	1	2	2	6	Installation procedures; Cable protection, e.g., burial; Chart Markings; Emergency contact available 24hrs per day; Emergency Response Cooperation Plan; Emergency shutdown system; Abandon gear; Inspection and maintenance procedures; Safety Zone; Kingfisher publications; Marine Coordinator on site during works; Navigational information broadcasts; Notice to Mariners; Notices to Fishermen| Notices to Fishermen; Promulgation of information to local users; Fisheries Liaison.	2	5	2	4	4	7.5	There is a low frequency of fishing in the Phase 1 areas. Fisheries liaison should be carried out to promulgate information on activities and works.
All	Navigation	Fishing vessel collision	Fishing vessel collides with wind turbine and/or offshore substations.	Lack of Passage Planning; Displacement of traffic; Engine Failure/ Blackout; Fatigue; Fouled propeller; Gear snagging; Human error; Bad weather; Lack of experience; Watchkeeper failure; Machinery Failure; Navigational Aid Failure; Personal injury (slips, trips, falls, heart attack); Poor Visibility; Radar interference; Steering Gear Failure; Vessels attracted to site - curiosity; Lack of awareness.	Vessel collides with structure with minor damage.	Vessel collides with structure and results in vessel being holed and sinking resulting in men overboard and potential fatalities.	3	2	2	2	2	6	Tug Availability; Safety Zone; Promulgation of information to local users; Notices to Fishermen| Notices to Fishermen; Notice to Mariners; Navigational information broadcasts; Marking and Lighting; Marine Coordinator on site during works; Kingfisher publications; Guard Vessel during Construction; Fisheries Liaison; Exclusion zone during construction; Compliance with Colregs; Chart Markings; Abandon gear.	2	5	2	3	4	7	There is a low frequency of fishing in the Phase 1 areas. Closed Circuit Television (CCTV) cameras were proposed on the turbines (at different points) and there is the potential for radar monitoring. This could be monitored from both shore and offshore, (e.g. on a mothership or on substations).
All	Navigation	Recreational vessel collision	Recreational vessel collides with wind farm structure.	Navigational Aid Failure; Engine Failure/ Blackout; Fatigue; Fouled propeller; Human error; Lack of awareness; Lack of experience; Bad weather; Machinery Failure; Watchkeeper failure; Personal injury (slips, trips, falls, heart attack); Poor Visibility; Radar interference; Steering Gear Failure; Structural Failure; Vessels attracted to site - curiosity; Lack of Passage Planning.	Vessel looses power and collides with wind farm structure resulting in minor damage.	Vessel looses power and collides with wind farm structure and results in vessel being holed and sinking resulting in people overboard and fatalities. Vessels on auto-pilot.	3	3	1	2	2	6	Promulgation of information to local users; Personal Protective Equipments (PPE); Passage Planning by Shipping; Notice to Mariners; Navigational information broadcasts; Minimum Blade Clearance; Marking and Lighting; Marine Coordinator on site during works; Continuous Watch by multi-channel VHF, including DSC; Compliance with Colregs; Chart Markings.	2	5	1	3	2	5.5	The main issue is yachts carrying out of date charts. The damage to a recreation vessel following a collision with a wind farm structure would be dependent on hull type, sea conditions and speed at contact.
All	Navigation	Cargo ship powered collision	Cargo vessel powered collision with the turbines or offshore substation.	Manoeuvring error; Displacement of traffic; Failure to comply with Colregs; Fatigue; Fire/ Explosion; Human error; Lack of awareness; Lack of experience; Bad weather; Machinery Failure; Watchkeeper failure; Navigational Aid Failure; Personal injury (slips, trips, falls, heart attack); Poor Visibility; Radar interference; Steering Gear Failure; Structural	Glancing blow off turbine or substation structure, significant damage to structure and damage to the vessels hull.	Turbine or substation structure collapse, vessel holed and sinks, potential fatalities and pollution.	2	3	2	3	4	6	Website showing sea obstructions by region; Safety Zone; Promulgation of information to local users; Passage Planning by Shipping; Notice to Mariners; Navigational information broadcasts; Monitoring system; MGN 372; Marking and Lighting; Marine Coordinator on site during works; Guard Vessel during Construction; Exclusion zone during construction; Compliance with Colregs; Chart Markings.	1	5	5	5	5	5	Tugs are available within the Firth of Forth.
Operation	Marine Renewables	Deliberate unauthorised boarding of/or mooring to structure and damage to device	Structures designed to allow access for inspection, maintenance and repair. There is potential for 'trespassers' to attempt to moor to or board a structure. This has the potential to lead to a member of the public falling into the sea or being stranded on a structure.	Vandalism; Protest.	Vessel moors alongside the structure or person climbs onto the structure in good weather and no damage. Its possible the reason for accessing the structure is to take part in protest requiring the emergency services. Potential for minor vandalism, e.g., graffiti.	Person is stranded / maintains protest on structure or falls into the sea as a result of climbing on the structure resulting in a fatality. Potential for more serious vandalism such as equipment damage.	4	1	1	1	3	6	Safety Zone; Safety Management System; Promulgation of information to local users; Inspection and maintenance procedures; Emergency shutdown system; Emergency Response Cooperation Plan; CCTV Coverage.	2	4	1	2	3	5	If a protestor gains access to a wind farm structure, the police and the UK Police Offshore Group would have jurisdiction.

Phase	Category	Hazard Title	Hazard Detail	Possible Causes	Most Likely Consequence	Worst Case Consequence	Most Likely						Risk Reduction	Worst Case						Notes
							Frequency	People	Environme	Property	Business	Risk		Frequency	People	Environme	Property	Business	Risk	
All	Navigation	Vessel-to-vessel collision due to avoidance of site or work vessels in area	Displaced traffic increases congestion outside of the site. This can lead to an increase in vessel-to-vessel encounters and risk of collisions.	Lack of Passage Planning; Communication failure; Displacement of traffic; Failure to comply with Colregs; Fatigue; Human error; Bad weather; Lack of awareness; Watchkeeper failure; Manoeuvring error; Navigational Aid Failure; Poor Visibility; Radar interference; Steering Gear Failure; Target not visible on radar; Installation not planned or carried out properly.	Damage to vessel(s) and possible injuries to crew(s).	Loss of vessel(s), pollution and potential loss of life.	2	3	2	3	3	5.5	Marine Coordinator on site during works; AIS fitted on all workboats working within site; AIS Transceiver; Compliance with Colregs; Continuous Watch by multi-channel VHF, including DSC; Emergency contact available 24hrs per day; Emergency Response Cooperation Plan; Adverse weather working policy and procedures; Guard Vessel during Construction; VTS Coverage of area; Marking and Lighting; MGN 372; Monitoring system; Passage plan to and from site; Passage Planning by Shipping; Routeing Measures - New or Amended; Exclusion zone during construction.	1	4	4	4	4	4	
All	Marine Renewables	Dropped object during work activities at site	Dropped object during construction, maintenance, decommissioning or lifting operations. Could also occur during an incident which results in a dropped object.	Installation not planned or carried out properly; collision leading to dropped object; Communication failure; Design Flaw; Fatigue; Fire/ Explosion; Bad weather; Human error; Structural Failure; Lack of awareness; Lack of experience; Machinery Failure; Manoeuvring error; Personal injury (slips, trips, falls, heart attack); Poor Visibility; Helicopter operations.	Dropped object into sea, falling onto the seabed. Financial loss, potential for damaging wind farm structure and/or the dropped object.	Dropped object onto vessel with fatality of persons working on the lifting operation. Damage to vessel.	3	2	1	3	1	5.2	Personal Protective Equipments (PPE); CDM Regulations; Control of Work Procedure; Exclusion zone during construction; Inspection and maintenance procedures; Installation procedures; Marine Coordinator on site during works; Adverse weather working policy and procedures; Marking and Lighting; Site personnel trained in fire fighting, first aid and offshore survival.; Personnel Training; Planning of major activities; Procedures for all vessels working in the site; Promulgation of information to local users; Safety Management System; Sharing of Information within Industry; Marine Operating Procedures.	2	4	1	4	4	6.5	A significant or large dropped object could be marked on admiralty charts
All	Navigation	Cargo ship drifting vessel collision	Cargo vessel looses power and drifts into turbines/substations.	Structural Failure; Steering Gear Failure; Poor Holding Ground; Machinery Failure; Lack of Passage Planning; Human error; Fouled propeller; Fire/ Explosion; Engine Failure/ Blackout; Dragged anchor; DP failure; Bad weather.	Glancing blow off turbine or substation structure, significant damage to offshore structure and damage to the hull of the vessel.	Significant damage, potential collapse of wind farm structure. Likely to be significant damage to the ships hull and injuries to crew.	2	2	2	3	3	5	Tug Availability; Operation and/or Maintenance vessel intervenes; Monitoring system; Marine Coordinator on site during works; Emergency Response Cooperation Plan; Anchoring by drifting vessel.	1	4	3	5	5	4.2	Tugs are available within the Firth of Forth.
Construction / Decommissioning	Marine Renewables	Increased navigational risks during construction and decommissioning	There could be an increased risk of vessels colliding with a structure during the construction phase due to lower awareness of offshore works and increased traffic from transient construction/decommissioning activities.	Lack of Passage Planning; Communication failure; DP failure; Failure to comply with Colregs; Fatigue; Helicopter operations; Human error; Bad weather; Lack of experience; Uncharted obstruction on seabed; Machinery Failure; Manoeuvring error; Marine coordinator; Navigational Aid Failure; Poor Visibility; Steering Gear Failure; Installation not planned or	A passing vessel could collide or be involved in a glancing collision with a partially constructed structure at the wind farm during the construction phase. The wind farm structure would sustain minor damage, with minor damage and injuries onboard the passing vessel.	A higher speed collision with wind farm structure during the construction phase resulting in serious damage to wind farm structure, the passing vessel and multiple injuries.	2	2	2	3	3	5	Work vessel display appropriate lights / marks; Safety Zone; Safety Management System; Procedures for all vessels working in the site; Planning of major activities; MGN 371; Marking and Lighting; Marine Coordinator on site during works; Installation procedures; Guard Vessel during Construction; Exclusion zone during construction; AIS fitted on all workboats working within site.	1	3	3	4	4	3.5	Vessel monitoring could take place during the construction phase.
All	Navigation	Fishing gear interaction with export cable	Fishing vessels drags gear over export cable(s), e.g., scallop dredger or trawler.	Lack of awareness; Human error; Gear snagging; Cable becomes exposed (unprotected cable).	Loss of fishing gear, minimal damage to cables.	Fishing vessel capsizes with loss of life, loss of vessel and pollution.	3	1	1	2	2	4.5	Notices to Fishermen| Notices to Fishermen; Inspection and maintenance procedures; Fisheries Liaison; Chart Markings; Cable protection, e.g., burial; Abandon gear.	2	5	2	2	4	6.5	There is a low frequency of fishing in the Phase 1 areas. The export cable will be trenched and possibly buried / raised above the sea bed if the cable cannot be protected in the sediment. Rock dumping could also be used to protect the export cable. Fisheries liaison should be carried out to promulgate information on activities and works.
Operation	Marine Renewables	Access to structure in an emergency situation	During an emergency situation, a vessel may need to moor with a wind farm structure or a person in the water may seek a safe haven on a turbine.	Bad weather; Any emergency situation.	A vessel enters the wind farm to seek a safe haven and moors to a wind farm structure. During this process a small level of damage may occur to both vessel and wind farm structure and persons involved could sustain minor injuries attempting to climb the structure.	A vessel enters the wind farm to seek a safe haven and moors to a structure. Minor damage occurs to both vessel and structure. The rotors may need shutdown if SAR operations are used to evacuate casualties. Injuries to people attempting to climb the structure.	3	2	1	1	2	4.5	Structure design; MGN 371; CDM Regulations.	2	3	1	2	3	4.5	Access ladders should be provided on wind farm structures for a distressed mariner.

C4. Summary of Key Findings

This section summarises the key findings of the Hazard Log workshop for the navigational risks associated with the proposed Phase 1 wind farms in the outer approaches to the Firth of Forth and Tay off the east coast of Scotland.

From the hazard ranking, several of the tolerable and worst case outcomes involve third party vessels. It is considered these incidents have a lower likelihood of occurring due to operator procedures and Safety Management Systems (SMS).

The key information summarised from the workshop relative to the proposed Phase 1 wind farms and wider region is presented below.

Search and Rescue/Emergency Response:

- The area is well covered in terms of Search and Rescue (SAR) – the Tay Bridge is equidistant between SAR helicopters at Boulmer, Prestwick and Lossiemouth.
- It was highlighted that tugs are on stand-by at the Hound Point / Braefoot Bay marine terminals.

Commercial Vessels:

- Regarding a drifting vessel collision it was highlighted that tugs are on stand-by at the Hound Point and Braefoot Bay marine terminals.
- An operation or maintenance vessel could intervene in a drifting vessel incident. It is likely that an operation or maintenance vessel would have towing capabilities (particularly if it is a multi-use vessel).

Recreational Vessels/Activities:

- In terms of a recreational vessel colliding with a wind farm structure in the Phase 1 sites, one of the main issues is yachts carrying out of date charts.

Fishing Issues:

- There is generally a low level of fishing in the Phase 1 areas. However, there could be a future increase in squid fisheries in the area as there are no quota restrictions.
- Inshore fishing in the area is carried out by vessels under 15m. However, in the future the Pittenweem fleet could change to fishing squid and vessels would operate further from shore (in and around the Phase 1 area.)
- The export cable will be trenched and possibly buried / raised above the sea bed if the cable cannot be protected in the sediment. Rock dumping could also be used to protect the export cable.
- A small vessel could lift a concrete mattress and therefore rock dumping is considered lower risk to gear/fishing vessels.
- In terms of the two proposed export cable routes, comments during the workshop indicated there was no difference in the impact to fishing from either the Arbroath or

Carnoustie cable corridors. Static fishing gear (including pots/creels) is located along the coastal areas and could be impacted during cable works.

Vessel Monitoring:

- The Forth Ports Vessel Traffic Service (VTS) area covers to Bell Rock.
- It was noted that Closed Circuit Television (CCTV) cameras were proposed on the turbines (at different points) and there is the potential for radar monitoring. This could be monitored from both shore and offshore, (e.g. on a mothership or on substations).
- The need for monitoring shipping during the construction and decommissioning phases was also raised.

Cumulative Issues (Regional Developments):

- A potential cumulative issue with vessel 'squeeze' was identified between Inch Cape and the Foxtrot site in Phase 2 of the Firth of Forth Round 3.
- The use of joint monitoring of vessels through the outer Firth of Forth and Tay region was noted. As part of this monitoring an information service could be provided to passing shipping.
- Concern was raised in relation to coastal traffic routeing around regional the developments. Deep draughted vessels could also pushed west of Bell Rock during an easterly wind. Tay bound traffic could be cumulatively impacted on approach, as the entrance to the Tay is narrow and there can be a localised swell in the area.
- The Firth of Forth to Scandinavia route could be impacted by Phase 2 and Phase 3, as vessels deviate around the sites increasing voyage time and fuel cost. (It is noted that re-routeing will be dependent on Phase 2 and Phase 3 developments as indicative project sites have been proposed at the current time [January 2012]).
- Concern was raised with regards to a potential 'choke point' off Bell Rock where two coastal routes will be forced inshore of the Inch Cape development.
- Navigational issues were raised in terms of the channel between Inch Cape and the Alpha/Foxtrot project areas in the Firth of Forth Round 3 Zone. The implementation of a Traffic Separation Scheme (TSS) in this channel was also noted.
- In terms of fishing activities, if vessels are required to route further inshore on coastal routes this could cumulatively impact inshore fishing grounds and static gear.

Hazard Workshop – Minutes of Meeting

Phase 1

(Appendix D)

Prepared by:	Anatec Limited
Presented to:	Seagreen
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TABLE OF CONTENTS

D1 Background

These minutes summarise the main points from the Hazard Review Workshop for the Firth of Forth Round 3 Zone 2, Phase 1 offshore wind farms (Project Alpha and Project Bravo) and associated export cable routes, held in Dunfermline on 18th January 2012.

The purpose of the Hazard Review Workshop was to identify and review the potential navigational hazards associated with the proposed Phase 1 offshore wind farms located in the Firth of Forth Round 3 Zone in the approaches to the Firth of Forth and Tay. The results form part of the Navigation Risk Assessment (NRA) for the proposed offshore wind farms.

D2 Attendees

The following table presents information on the navigational review workshop attendees.

Table 1 List of Attendees for Phase 1 Navigation Hazard Review Workshop

Attendee	Position	Company/Organisation
Peter Douglas	Navigation Manager	Northern Lighthouse Board (NLB)
Archie Johnstone	Navigation Officer	Northern Lighthouse Board (NLB)
Pete Thomson	Offshore Energy Liaison Officer	Maritime and Coastguard Agency (MCA)
Scott Horsburgh	Marine Superintendent	Marine Scotland
Archie MacCallum	Commanding Officer, *MPV Hirta*	Marine Scotland
Bill Hughes	Manager of Fisherman's Mutual Association (FMA) (Pittenweem) Ltd	Kingdom Seafood/FMA Ltd
Sandy Ritchie	Secretary	Anglo-Scottish Fisherman's Federation
John Watt	Fishing Industry Advisor	Scottish Fisherman's Federation
Ashley Nicholson	Assistant Marine Manager	Forth Ports Ltd.
Leanne Fisher	Marine Officer	Forth Ports Ltd.
Graham Russell	Planning and Environment Officer	Royal Yachting Association (Scotland)
Robert Waterston	Interim Project Developer for Seagreen Wind Energy	URS Infrastructure & Environment UK Limited
Naomi Healey-Cathcart	Project Manager Offshore Development	Seagreen Wind Energy Ltd
Mike Cain	Senior Risk Analyst	Anatec Ltd
Robert Jones	Risk Analyst	Anatec Ltd

D3 Apologies

Seagreen stated that apologies had been received from the following individuals who were unable to attend the Hazard Review Workshop:

- Tony Kirk, James Fisher Everard;
- Richard Nevinson, Chamber of Shipping;
- Peter Bury, Cruising Association (CA);
- Ian Miller, Scottish Canoe Association (SCA) / Fife Sea Kayak; and
- Paul Jennings, Royal National Lifeboat Institution (RNLI).

The above individuals requested if they could be informed of the outputs from the Hazard Review Workshop.

D4 Minutes

The key notes from the shipping and navigation hazard workshop for the Phase 1 wind farms and associated export cable routes are summarised in the following sub-sections.

1.1 General

- Seagreen gave an introduction to the project, overview of the Phase 1 sites and a summary of the anticipated construction timetable. Seagreen stated that the application for consent to construct the Phase 1 sites will be submitted to the Scottish Government (Marine Scotland) in August 2012.
- Anatec provided a baseline shipping and navigation overview of the Phase 1 sites and export cable route options.

1.2 Search and Rescue/Emergency Response

- The NLB pointed out that the Search and Rescue (SAR) facility at RAF Boulmer will close in 2015 as part of the UK SAR restructuring programme.
- MCA stated that the area is well covered in terms of SAR – the Tay Bridge is equidistant between SAR helicopters based at Boulmer, Prestwick and Lossiemouth.
- Seagreen asked which base would likely serve the Phase 1 wind farms. The MCA stated it would depend on the availability of SAR helicopters at the time of emergency request.
- MCA and NLB noted that consideration should be given to the Emergency Response capability of the vessels permanently in operation in the zone.
- MCA stated that as part of commitments by the developer, an access ladder (or point of refuge) should be provided on wind farm structures for a distressed mariner. The MCA stated that reference is made within Marine Guidance Note (MGN) 371 regarding the consideration of access ladders on each turbine or substation for distressed mariners.
- Following the general discussion of access to wind farm structures by a distressed mariner, it was noted that access points (e.g. ladders) could allow unauthorised access to wind farm structures (increasing the risk of vandalism/deliberate damage). However, it was noted that CCTV coverage at the wind farm could provide a means of monitoring access to structures.
- It was highlighted by Forth Ports that tugs are on stand-by at the Hound Point / Braefoot Bay marine terminals.

1.3 Offshore Safety Zones

- A question was raised about the size of safety exclusion zones required during the construction phase of the wind farms. In general, 500m safety exclusion zones are put in place around the major construction works, including Jack-up's and construction barges.
- As construction works are likely to be phased, the safety zones will 'roll' onto the next construction site/area. Seagreen will apply for safety zones via Department for

Energy and Climate Change (DECC) Guidance Notes*: Applying for Safety Zones around Offshore Renewable Energy Installations* (DECC, 2007).

- RYA noted that it would be acceptable to have safety zones during the construction and decommissioning phases, as a small number of sailing vessels could be intrigued by the offshore works and pass closer to the site, while other vessels may not be aware of works.
- The RYA also stated that in general they see less of a requirement for safety zones during the operational phase (this point was also raised under the Recreational Vessels/Activities section).
- The NLB would require any safety zone to be 'pegged' for the duration any exclusion agreement.

1.4 Fishing Related Issues

- SFF noted that there was generally a low level of fishing activity in the Phase 1 areas.
- SFF stated that scallop vessels travel around the whole of the UK depending on the season.
- SFF stated there could be a future increase in squid fisheries in the area (e.g. like in the Moray Firth) as there are no quota restrictions. Vessels of around 30m in length could also target this species.
- Anglo-Scottish Fisherman's Federation noted that in general inshore fishing was carried out by vessels under 15m. However, in the future the Pittenweem fleet could switch effort to squid fishing and vessels would operate further from shore (in and around the Phase 1 area.)
- Seagreen stated that the export cable could be trenched and buried depending on ground conditions and the preferred engineering solution. General consensus was that fishing operators would object to unprotected laid cables.
- SFF noted that it is possible that a small vessel could lift a concrete mattress if snagged, which could lead to the vessel being toppled in extreme cases. In terms of risk to gear/fishing vessels, rock dumping (armour) is considered less of a risk compared to concrete matressing due to a lower risk of gear becoming snagged. The SFF commented that the oil and gas industry have made great improvements in recent years in improving the design of rock armouring, in particular through the use of smaller rock pieces (typically 3-5 inches).
- The point was made that a vessel had been lost in 1997 due to gear becoming snagged on an abandoned oil well-head. This highlights the need for subsea infrastructure (including temporary structures) to be surveyed, marked and communicated to other marine users, i.e. fishing vessels.
- The Anglo-Scottish Fisherman's Federation representative noted the importance of fisheries liaison when laying cables. The point was also made that future liaison should be made with the Fisheries Liaison Officers and not individual fisherman.
- In terms of the two proposed export cable routes, the general consensus from the fishing representatives was that there was no difference in the impact to fishing from either the Arbroath or Carnoustie cable corridors. However, static gear (including pots/creels) is located along the coastal areas and could be impacted during cable works.

- There was a point raised regarding the appropriateness of guard vessels versus awareness vessels. The SFF suggested that awareness vessels be used during offshore works, or when structures are partially constructed, as fishing vessels can communicate well with awareness vessels (especially if these are fishing vessels).

1.5 Aids to Navigation and Vessel Monitoring

- During a discussion on the risks associated with the construction and decommissioning phases of the project, NLB noted that buoys/lights (e.g. flashing yellow 5 seconds [Fl Y 5s]) and guard vessel(s) could be used at each partially constructed turbine.
- At the current time, indicative lighting can only be predicted; however NLB stated that cardinals could be used to mark temporary structures.
- Red aviation lighting was discussed as a number of mariners have observed the red light to flash under certain conditions (dependent on wind direction, distance and blade speed) when navigating near offshore wind farms. NLB noted that discussions have taken place with the Civil Aviation Authority (CAA) regarding mitigating this effect by using a different light (i.e. white) or cupping the light so that it cannot be observed by mariners. NLB also highlighted that there were on-going trials taking place by the General Lighthouse Authorities (GLAs) regarding the conflicts between SAR, aviation and navigational lighting flashing and causing mariner confusion. The NLB indicated information and results of on the trials would be released soon.
- NLB confirmed receipt of Seagreen's Met Mast Application for the Phase 1 area. NLB wish Seagreen to note that if only one structure is to be built it would require different marking and lighting compared with the same structure if it is in combination with additional structures.
- Forth Ports noted that they have AIS coverage in the Bell Rock area, however there is limited Radar coverage and no active monitoring of this area at present.
- Seagreen noted that CCTV cameras were proposed on the turbines (at different points) and there is the potential for radar monitoring. This could be monitored from both onshore and offshore locations, (e.g. on a mothership or on substations).
- The need for monitoring shipping activity during the construction and decommissioning phases was also raised.

1.6 Recreational Vessels/Activities

- The RYA noted that the survey data gathered for the Phase 1 project was aligned with the Recreational Atlas routes.
- In terms of a recreational vessel colliding with a wind farm structure in the Phase 1 areas, RYA stated that one of the main issues is yachts carrying out of date charts.
- Ensuring good awareness amongst recreational users was noted to be important especially during the construction and decommissioning phases. The use of the Kingfisher National Notification System, was highlighted (especially useful 'for non-local' vessels).

1.7 Other Issues

- Seagreen noted that during the construction phases, works are expected to take place 24 hours per day. The risks to navigation are likely to be higher during hours of darkness.
- It was noted that the UK Police only have jurisdiction out to 12 nautical miles (nm). The Seagreen project is therefore outside of this area. The MCA stated that the issue of policing offshore wind farms outside the 12nm limit is currently being considered by the UK Police Offshore Energy Group (UKPOEG).

1.8 Cumulative Issues

- During a discussion on vessel-to-vessel collision due to avoidance of site or support vessels in the area, the MCA noted the potential for vessels to be 'squeezed' around the regional wind farm developments and that the NRA would have to consider this.
- Forth Ports also noted potential cumulative issues with vessel 'squeeze' – most notably between Inch Cape and the Foxtrot site in Phase 2 of the Firth of Forth Round 3 Zone 2.
- Forth Ports suggested that consideration be given to monitoring vessels where congestion increases were found to be significant.
- Concern was also raised by Forth Ports in relation to coastal traffic routeing around the regional developments. Their main concern was if deep draughted vessels could be pushed west of Bell Rock during an easterly wind.
- If a north-south channel is considered as part of the original mitigation solution, Forth Ports raised the issue that they would be unhappy if north-south navigation was being channelled without either sufficient space and/or a traffic management strategy being agreed in advance.
- Forth Ports pointed out that the Firth of Tay route could be cumulatively impacted by the regional developments on approach, as the entrance to the Tay is narrow. Furthermore, it was stated that there is a history of large localised swell in the area.
- Forth Ports noted that if the Forth Zone were fully developed to the south, the Firth of Forth to Scandinavia route, which passes through the southern part of the Firth of Forth Round 3 Zone, could be impacted in terms of deviations which will increase voyage time and fuel cost.
- NLB stated they were concerned with a potential 'choke point' off Bell Rock where two coastal routes will be forced inshore as a result of the Inch Cape development.
- Forth Ports raised potential safety issues in terms of navigating within the channel between Inch Cape and the Alpha/Foxtrot project areas in the Firth of Forth Zone.
- In terms of fishing activities, if vessels are required to route further inshore on coastal routes this could impact inshore fishing grounds and static gear.

EEMS Maritime Traffic Survey Report

Phase 1

(Appendix E)

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Presented to:	Seagreen
Date:	17th May 2011
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TABLE OF CONTENTS

E1. Introduction

1.1 *Background*

This report presents analysis of a 14 day shipping traffic survey which has been carried out from the *EEMS* offshore supply tug during March 2011 (12th to 25th). The data was collected using radar, AIS and visual observations.

1.2 *Abbreviations*

The following abbreviations are used throughout the report:

AIS	-	Automatic Identification System
ARPA	-	Automatic Radar Plotting Aid
CPA	-	Closest Point of Approach
DWT	-	Dead Weight Tonnage
IMO	-	International Maritime Organisation
MCA	-	Marine Coastguard Agency
MGN	-	Marine Guidance Note
MMSI	-	Mobile Maritime Service Identity
nm	-	Nautical Miles (1nm = 1,852 metres)
SOLAS	-	Safety of Life at Sea
VHF	-	Very High Frequency
UTC	-	Coordinated Universal Time (equivalent to GMT)

E2. Survey Set-up

2.1 *Introduction*

A maritime traffic survey of the Forth Round 3 Phase 1 area was carried out from the *EEMS* offshore supply tug (Figure 2.1). The objective of the survey was to collect data on vessel movements in the area during the winter/spring period.

According to the its AIS broadcast by the EMMS, the vessel went to anchor at 03:22 Hrs on Saturday 12th March 2011 and left anchor at approximately 02:44 Hrs on Saturday 26th March 2011. It is noted that coverage of the area was achieved during arrival to the location and overall there was 14 days of data recorded.

Figure 2.1 Library Picture of the Vessel *EEMS*

The primary objective of the survey was to identify and validate the routeing of vessels and the level of vessel activity in and around the Phase 1 site in the Forth Round 3 zone. This was achieved by recording in real-time the positions of vessels within range of the Automatic Identification System (AIS) receiver and Automatic Radar Plotting Aid (ARPA) radar as well as being supplemented by observation of vessels within visual range to obtain information on type and size where the information was not available from AIS.

2.2 *Survey Location*

An overview and detailed chart of the Phase 1 area, within the northern section of the Forth Round 3 zone is presented in Figure 2.2 and Figure 2.3.

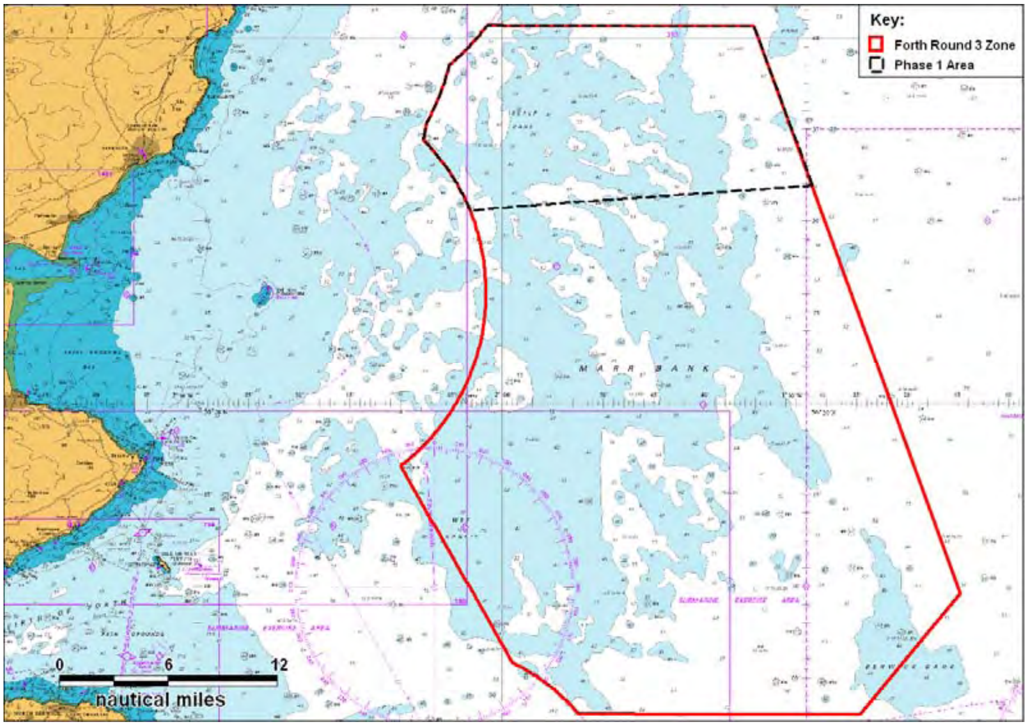

Figure 2.2 Chart Overview of the Phase 1 Area and Round 3 Zone

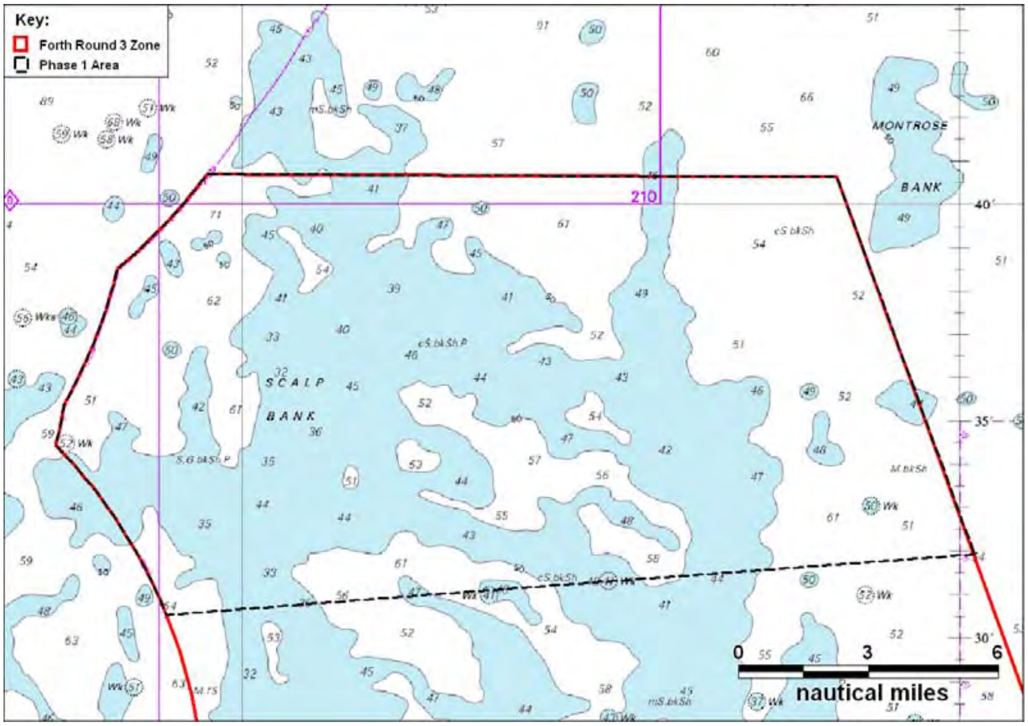

Figure 2.3 Detailed Overview of the Phase 1 Area

Figure 2.4 presents a detailed overview of Phase 1 and the tracks of the survey vessel *EEMS* during the survey.

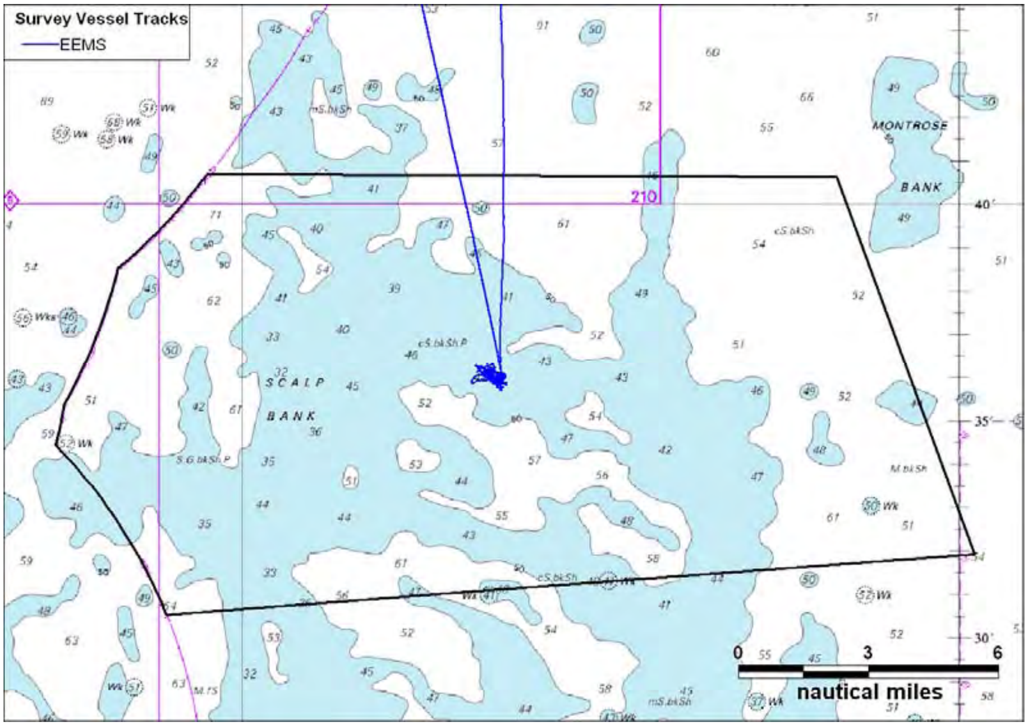

Figure 2.4 Chart Overview of Phase 1 and Survey Vessel Tracks

2.3 *Equipment and Manning*

Table 2.1 lists the equipment used to carry out the traffic survey.

Table 2.1 Equipment utilised in Traffic Survey

Equipment	Purpose
Radar: Furuno FAR 2xx7 Series and Display Unit MU-201 CR	Tracking of non-AIS targets (manually and automatically)
AIS: Transas M-2	To receive and record data from vessels transmitting AIS data.
Nautical Compass	Used to verify bearing of vessels.
Binoculars	Visual identification of vessels.
Digital Camera	Photographic evidence of targets (when possible)
Notebook PCs	Connected to radar and AIS receiver for real-time recording of tracked target data. Tracked targets displayed on hydrographic charts.
Logbook	Written log of all manual targets acquired during survey as well as other notes such as visual identification information, weather conditions, etc.

The survey was conducted 24 hours per day. The AIS and Radar systems tracked targets 24 hours per day during the survey period. During the survey a visual lookout was maintained and all observations were recorded in the logbook.

For the majority of time radar observations were made within 12nm range which facilitated the tracking of all vessels passing through the Phase 1 area. The radar range varied based on conditions and target details but typically vessels were tracked up to 12nm from the survey vessel and some targets beyond 14nm. However, it is noted that the maximum visibility range from the bridge of *EEMS* was approximately 10nm; therefore occasionally visual identification was established after a non-AIS target had been acquired. In addition, small and/or high speed targets were sometimes not picked-up/acquired on radar at first sighting and therefore targets were re-acquired leading to a small number of broken tracks for the same vessel/target.

The AIS system automatically tracked all targets within range, which again varied depending on conditions, but was typically at least 20nm. It is also noted that occasionally smaller vessels including sailing yachts and small fishing boats that are not mandatorily required to carry AIS may install a less expensive, lower power version called Class B AIS. Occasionally these vessels can be dropped off / picked up when at the edge of recordable range, i.e. 10-15nm.

2.4 *AIS Description*

Regulation 19 of SOLAS Chapter V - Carriage requirements for ship borne navigational systems and equipment - sets out navigational equipment to be carried on board ships, according to ship type. In 2000, IMO adopted a new requirement (as part of a revised new chapter V) for ships to carry automatic identification systems (AIS). AIS is a system by which ships transmit data concerning their position, MMSI etc on two individual VHF channels to the shore and other vessels, at very frequent intervals. The data is transmitted automatically via VHF to other vessels and coastal stations/authorities.

The regulation requires AIS to be fitted aboard 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 passenger ships irrespective of size built on or after 1 July 2002. It also applies to ships engaged on international voyages constructed before 1 July 2002, according to the following timetable:

- passenger ships, not later than 1 July 2003;
- tankers, not later than the first survey for safety equipment on or after 1 July 2003;
- ships, other than passenger ships and tankers, of 50,000 gross tonnage and upwards, not later than 1 July 2004.

An amendment adopted by the Diplomatic Conference on Maritime Security in December 2002 states that ships, other than passenger ships and tankers, of 300 gross tonnage and upwards but less than 50,000 gross tonnage, will be required to fit AIS not later than the first safety equipment survey after 1 July 2004 or by 31 December 2004, whichever occurs earlier.

Ships fitted with AIS shall maintain AIS in operation at all times except where international agreements, rules or standards provide for the protection of navigational information.

The regulation requires that AIS shall:

- provide 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;
- receive automatically such information from similarly fitted ships; exchange data with shore-based facilities.

Both dynamic and static information are transmitted by the vessel. Table 2.2 presents the dynamic and static data provided via AIS.

Table 2.2 AIS Information

Static	Dynamic	Voyage related
MMSI	Position (Lat/Long)	Draught
IMO Number	Time	Hazardous Cargo (type)
Call Sign	Course over ground	Destination
Name	Speed over ground	ETA
Length and Beam	Heading	Route Plan
Type of Ship	Navigational Status	
Type of Nav Sensor	Rate of Turn	

2.5 *Weather Data*

The weather was recorded in a logbook 4 times per day during the survey and this is presented in Table 2.3.

The wind direction was predominantly from the south west and west, with two days recording largely variable wind speeds. The wind speed for the survey was generally Force 3 to 4 on the Beaufort scale, with a maximum of Gale Force 9 experienced on the 14th March and 20th March 2011.

Table 2.3 Weather Log for Phase 1 Survey (14 Days)

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
12th March	08:00	NE	6	Moderate	4	Low Cloud
	12:00	NE	6 to 7	Moderate/Rough	4 to 5	Rain
	16:00	NE	6 to 7	Moderate/Rough	4	Rain
	20:00	NE	6	Moderate	Dark	Rain
13th March	08:00	NW	5 to 6	Slight/Moderate	7	High Cloud/Grey
	12:00	NW	5	Slight/Moderate	9	High Cloud/Grey
	16:00	N-NW	5 to 6	Slight/Moderate	7 to 8	Clear to East
	20:00	N-NW	7 to 10	Moderate/Rough	Dark	Rain/Strong wind
14th March	08:00	N	Gale 9	Very Rough	2 to 3	4 to 5 Swell
	12:00	N	9/8 (decreasing)	Very Rough	2	Driving Rain/Swell
	16:00	N	4	Slight	7	Wind Dropped/Swell
	20:00	N	2 to 3	Slight	Dark	Wind Dropped
15th March	08:00	E	3 to 4	Slight	5	Grey Cloud
	12:00	E-SE	5	Moderate	5	Drizzle
	16:00	E-SE	6	Moderate	~150m	Thick Fog/Cloud
	20:00	SE	6	Moderate/Rough	Dark	Wind/Rain

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
16th March	08:00	Variable	1 to 2	Slight	9	Sun/Light Cloud
	12:00	Variable	1 to 2	Slight	9	Large Residual Swell
	16:00	Variable	1 to 2	Slight	100m	Fog/Swell
	20:00	E	5 to 6	Moderate/Rough	Dark	Wind Increasing
17th March	08:00	NE	4	Slight	6	Overcast/Swell
	12:00	NE	4 to 5	Slight/Moderate	6	Overcast/Large Swell
	16:00	Variable	1 to 2	Slight	9	Sun/Light Cloud
	20:00	E	4 to 5	Slight/Moderate	Dark	Clear/Windy
18th March	08:00	W	3	Flat/Slight	9	Sun/Clear
	12:00	W	3 to 4	Flat/Slight	9	Sun/Clear
	16:00	W-SW	5	Slight/Moderate	9	Sun/Clear
	20:00	W	5 to 6	Slight/Moderate	Dark	Clear
19th March	08:00	W	3	Slight	9	Sun/Clear
	12:00	W	3 to 4	Slight	9	Sun/Clear
	16:00	W	2 to 3	Flat/Slight	8	Sun/Light Cloud
	20:00	N	2	Flat/Slight	Dark	Clear
	08:00	NE	2	Flat/Slight	7	Overcast

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
20th March	12:00	NE	4	Flat/Slight	7	Overcast
	16:00	SE	3	Slight	8 to 9	Sun/Clearing
	20:00	SW	Gale 9 (increasing)	Moderate	Dark	Wind Increasing
21st March	08:00	SW	7	Moderate	7	Hazy Sun/Light Cloud
	12:00	SW	6	Moderate	8	Sun/Partly Cloudy
	16:00	SW	6	Moderate	5	Sun with Haze
	20:00	SW	4	Slight/Moderate	Dark	Clear
22nd March	08:00	SW	1 to 2	Flat	9	Sunny/Clear
	12:00	SW	2	Flat/Slight	9	Cloud/Overcast
	16:00	SW	< 1	Flat	7	Cloud/Overcast
	20:00	SW	< 1	Flat	Dark	Cloud/Overcast
23rd March	08:00	SW	5	Slight	9	Sun/Clear
	12:00	W-SW	5	Slight	7	Sun with Haze
	16:00	SW	2 to 3	Flat	5 to 6	Overcast/Haze ~6nm
	20:00	SW	< 1	Flat	Dark	Partly Cloudy
24th March	08:00	Variable	0	Flat	9	Flat Calm
	12:00	Variable	0	Flat	9	No Wind

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
	16:00	Variable	0	Flat	5	Sun with Haze
	20:00	Variable	0	Flat	Dark	Cloud
25th March	08:00	W-SW	1 to 2	Flat	8	Overcast
	12:00	W-SW	2	Flat	8	Overcast
	16:00	W	2	Flat	6	Overcast
	20:00	W	2	Flat	Dark	Cloud

2.6 *Tidal Data*

Tidal data for the area has been taken from Montrose, approximately 13nm to the west of Phase 1, and is presented in Figure 2.5 (overleaf).

There was a spring tide on Monday 21st March when the tide ranged from 0.2m to 5.5m above chart datum, and a neap tide on the Monday 14th March when low and high waters were 2.2m and 3.8m above chart datum

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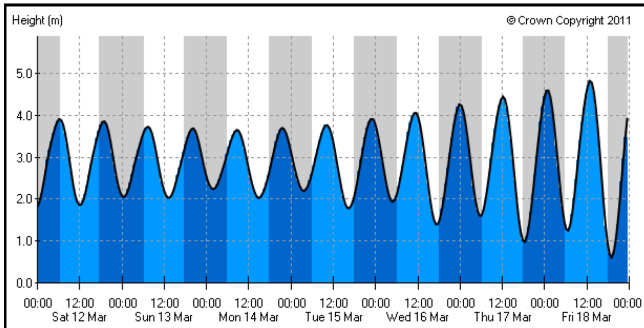
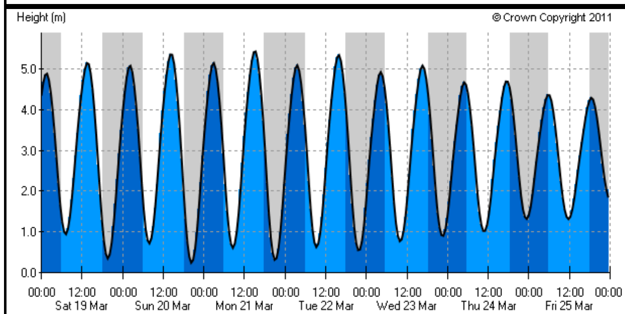


Sat 12 Mar			Sun 13 Mar				Mon 14 Mar				Tue 15 Mar				Wed 16 Mar				Thu 17 Mar			Fri 18 Mar			
HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW
06:17	12:00	18:50	00:28	07:20	13:14	20:06	01:52	08:41	14:47	21:31	03:30	10:03	16:15	22:55	04:49	11:16	17:19	23:59	05:42	12:11	18:09	00:47	06:26	12:57	18:53
3.9 m	1.9 m	3.9 m	2.1 m	3.7 m	2.0 m	3.7 m	2.2 m	3.7 m	2.0 m	3.7 m	2.2 m	3.8 m	1.8 m	3.9 m	1.9 m	4.1 m	1.4 m	4.3 m	1.6 m	4.4 m	1.0 m	4.6 m	1.2 m	4.8 m	0.6 m



Sat 19 Mar				Sun 20 Mar				Mon 21 Mar				Tue 22 Mar				Wed 23 Mar				Thu 24 Mar				Fri 25 Mar		
HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW
01:30	07:09	13:39	19:37	02:10	07:50	14:20	20:19	02:50	08:31	15:03	21:02	03:30	09:14	15:47	21:44	04:13	09:58	16:34	22:29	04:57	10:45	17:28	23:17	05:46	11:39	18:29
4.9 m	0.9 m	5.2 m	0.4 m	5.1 m	0.7 m	5.4 m	0.2 m	5.2 m	0.6 m	5.4 m	0.3 m	5.1 m	0.6 m	5.3 m	0.5 m	4.9 m	0.8 m	5.1 m	0.9 m	4.7 m	1.0 m	4.7 m	1.3 m	4.4 m	1.3 m	4.3 m

Figure 2.5 Tidal Predictions for Montrose during Survey Period (Source: Admiralty Tides, UTC Times)

E3. Overview Survey Results

3.1 *Introduction*

This section presents an overview of the vessel tracks recorded on AIS and radar (non-AIS) during the survey period relative to a 10nm radius from the Forth Round 3 Zone and Phase 1.

The AIS and radar data has been combined. Approximately 95% of all vessels recorded within 10nm of the Forth Round 3 Zone and Phase 1 were fitted with AIS. As the AIS receiver tended to track vessels over a greater range, and also provided more accurate information on position and ship characteristics, the AIS track has been used where the vessel was tracked by both systems. For vessels which had no AIS and were tracked by radar (5%), these have been added to the AIS data to create a single combined data set of all vessels.

The tracks have been colour-coded by vessel type. This information was available from the vast majority of vessels fitted with AIS. Non-AIS radar tracks have been colour-coded based on visual observations, where available.

3.2 *Tracks by Type*

An overview of the combined tracks recorded over the survey period colour-coded by vessel type is presented in Figure 3.1.

It is noted that *EEMS* and other non-routine survey vessels working in the area (fisheries research vessel *Alba Na Mara*, benthic / bird survey vessel *Clupea*, and Metocean / wind farm survey vessel *Shemarah II LH65*) are excluded from the following analysis.

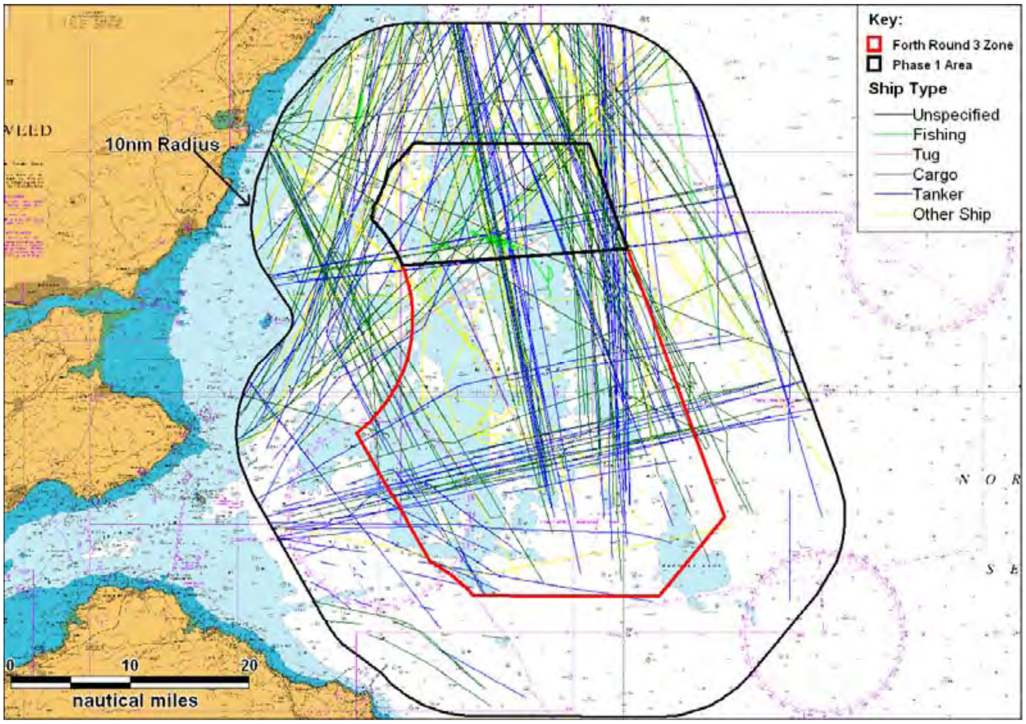


Figure 3.1 Overview of Combined Survey Data by Ship Type (14 Days)

Coverage from the Phase 1 survey extended 10nm from the northern part of the Round 3 Zone, with coverage decreasing (dropping-off) to the south of Zone.

The average number of tracks per day within 10nm of the Forth Zone was 20 based on 14 days of surveying. The busiest day during the survey was Saturday 19th March when 30 tracks were recorded, presented in Figure 3.2).

The quietest day was Tuesday 15th March when 10 tracks were recorded (presented in Figure 3.3). The volume of traffic recorded passing the survey location each day was generally consistent over the duration of the survey.

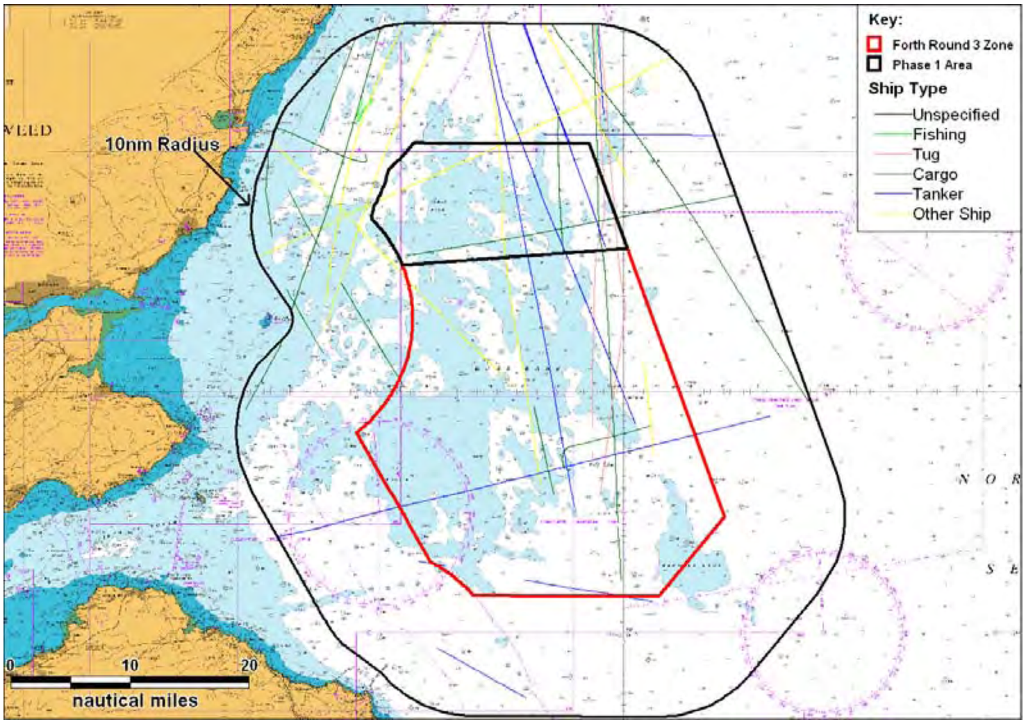


Figure 3.2 Overview of Combined Survey Data on Busiest Day (19 March 2011)

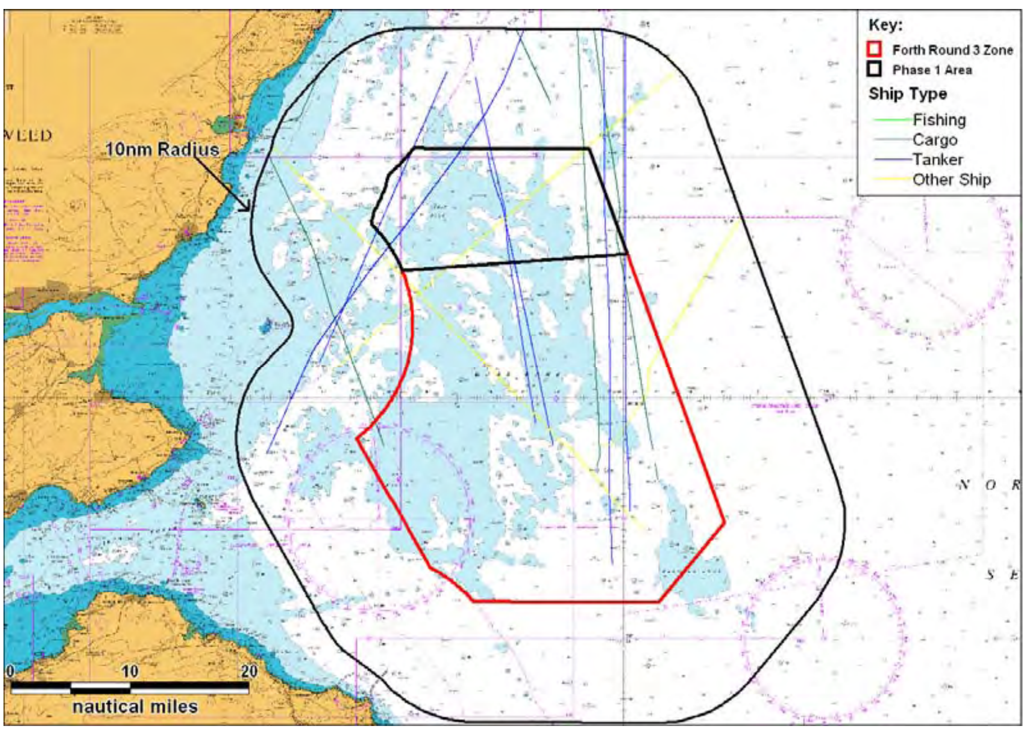


Figure 3.3 Overview of Combined Survey Data on Quietest Day (15 March 2011)

3.3 *Tracks by Size (Draught and Length)*

Based on the information available from AIS and radar observations, the tracks colour-coded by length and draught (where available) are presented in Figure 3.4 and Figure 3.5.

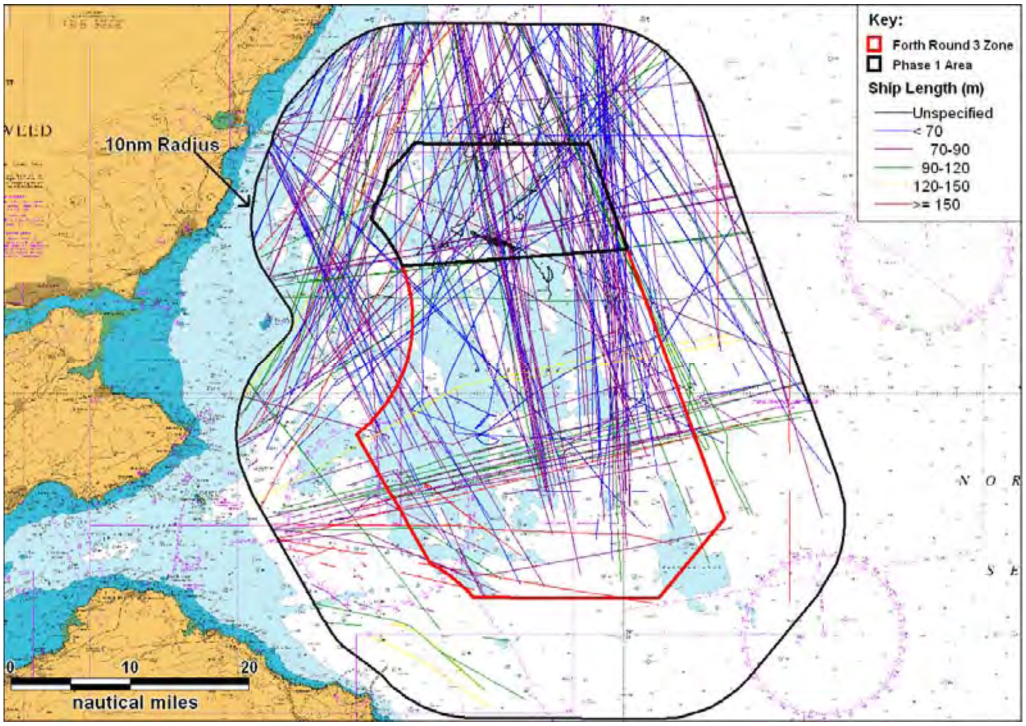


Figure 3.4 Overview of Combined Survey Data by Ship Length (14 Days)

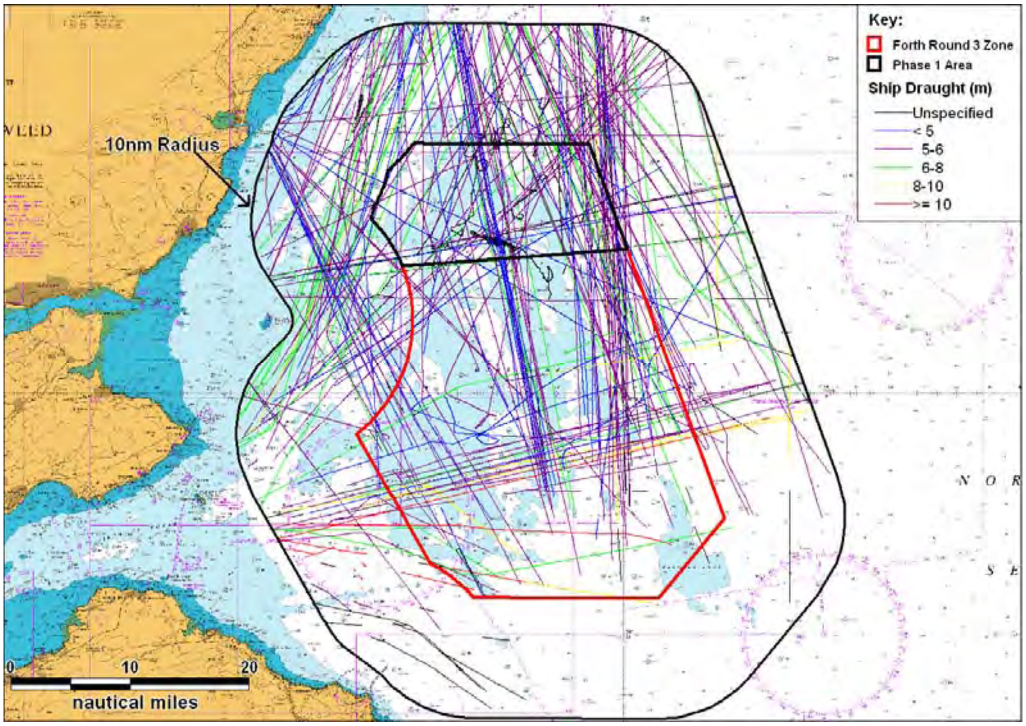


Figure 3.5 Overview of Combined Survey Data by Ship Draught (14 Days)

E4. Detailed Survey Results

4.1 *Introduction*

This section presents a detailed analysis of the vessel tracks recorded on AIS and radar during the survey period relative to the Phase 1 area. The following analysis is presented:

- Ship Type
- Daily Numbers
- Ship Length
- Ship Draught
- Ship Speed
- Average Course
- Destination
- Anchored Ships

4.2 *Shipping Levels and Types*

A plot of the combined data (excluding survey vessel tracks) recorded within 10nm of Phase 1 colour-coded by vessel type is presented in Figure 4.1. It is noted that within 10nm of Phase 1 the survey data composed of 93% AIS and 7% non-AIS vessels.

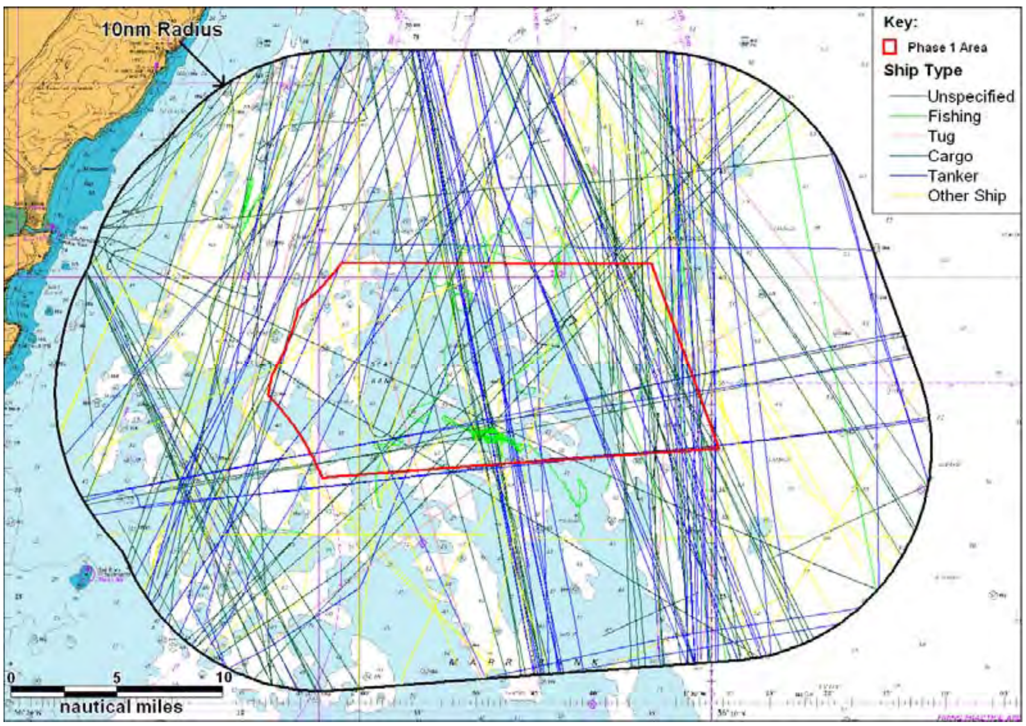


Figure 4.1 Combined Survey Data by Type within 10nm of Phase 1

In total there was an average of 16 vessels per day passing within 10nm of Phase 1 during the 14 day survey in March 2011.

Figure 4.2 presents the daily number of vessels passing through Phase 1 during the survey period.

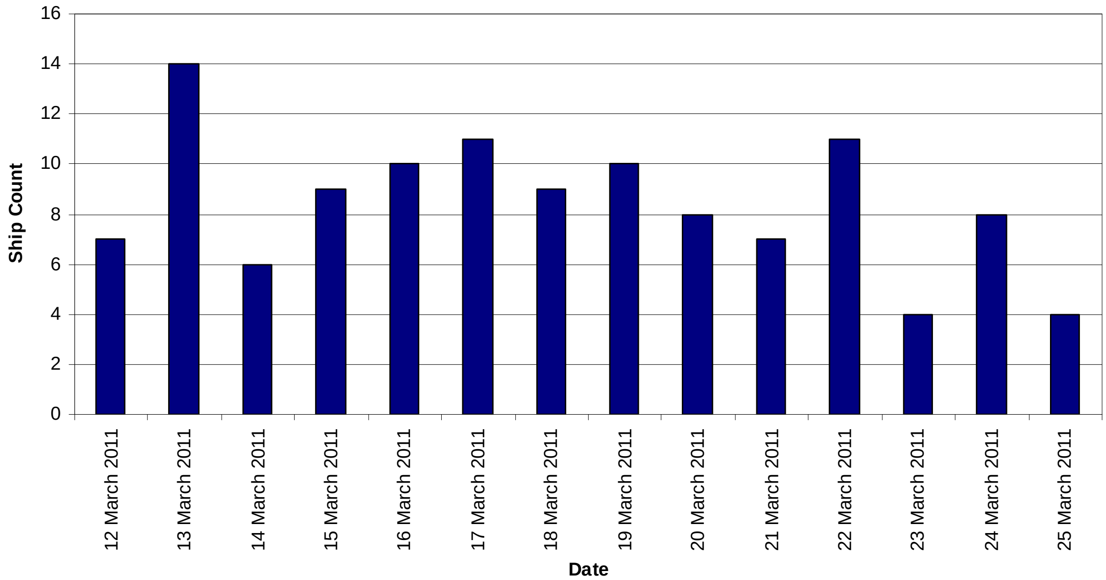


Figure 4.2 Vessels per day Intersecting Phase 1

There was an average of 8 vessels per day passing through Phase 1, with the majority of tracks recorded on AIS vessels (91%) as opposed to non-AIS radar tracks (9%).

The busiest day for vessels passing through the site was Sunday 13th March with 14 vessels recorded. The quietest days were Wednesday 23rd and Friday 25th March with 4 vessels through Phase 1.

Plots of the busiest and one of the quietest days passing through Phase 1 are presented in Figure 4.3 and Figure 4.4.

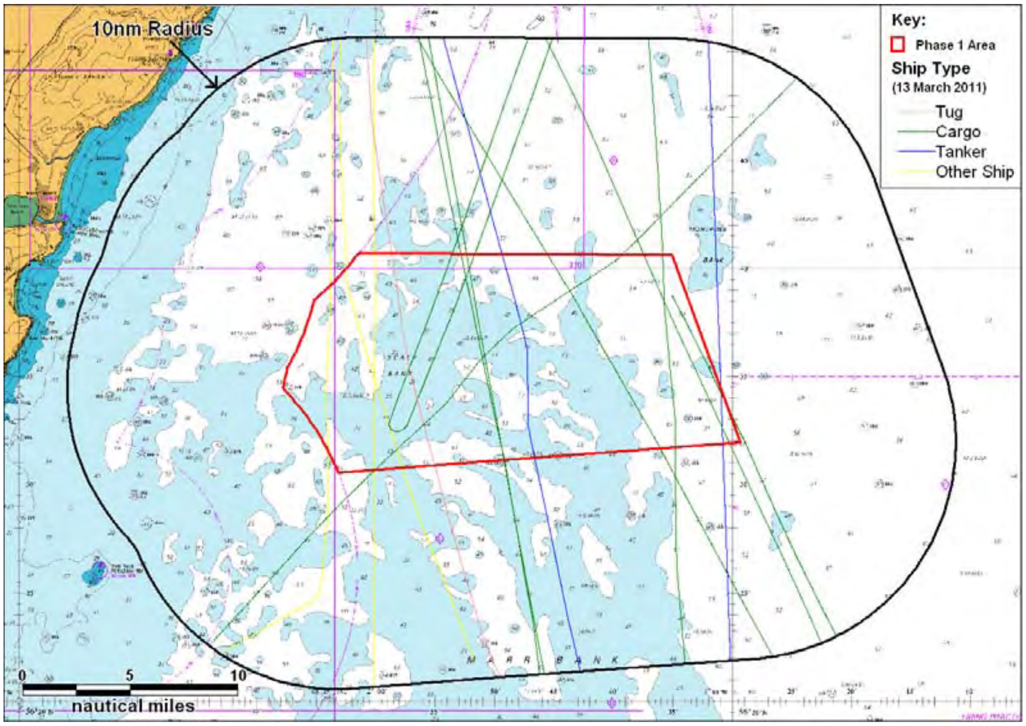


Figure 4.3 Vessels Intersecting Phase 1 - Busiest Day (13 March 2011)

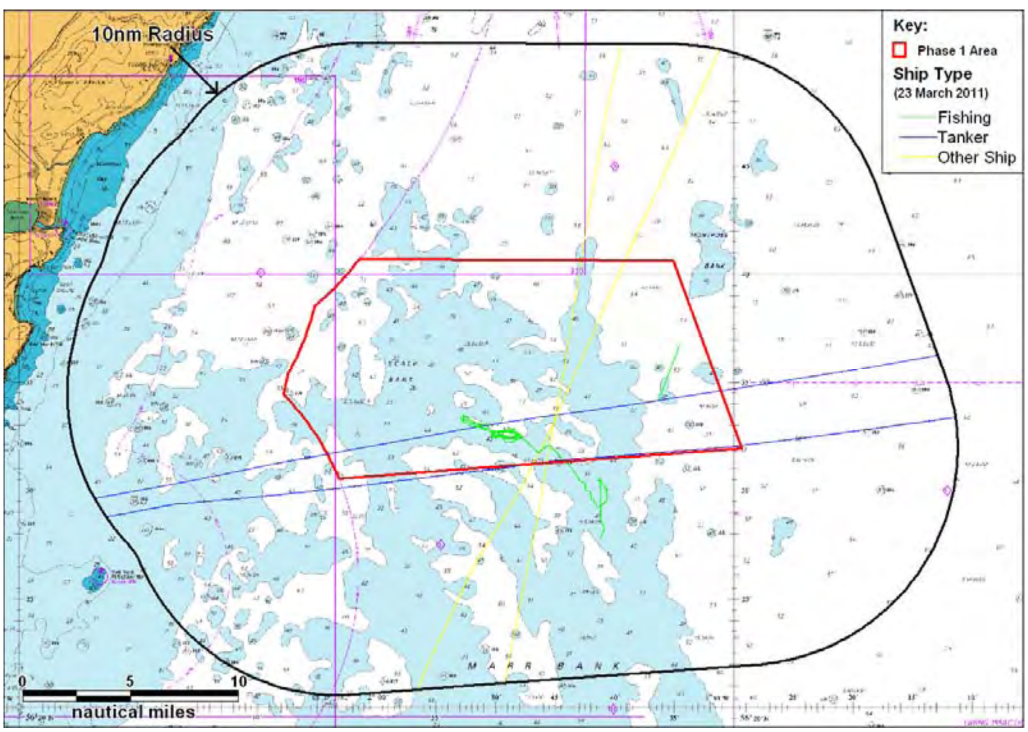


Figure 4.4 Vessels Intersecting Phase 1 – One of the Quietest Days (23 March 2011)

Figure 4.5 presents the type distribution for vessels passing through Phase 1 (excluding 4% unspecified).

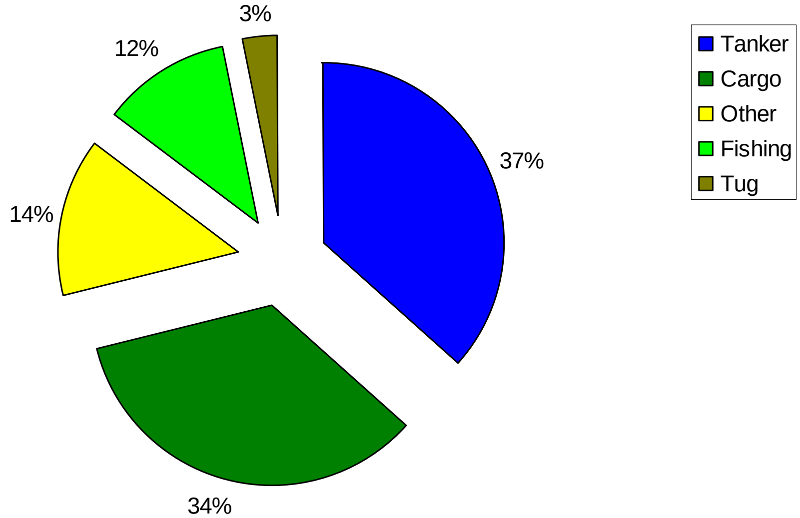


Figure 4.5 Vessel Type Distribution Passing through Phase 1

Tankers and cargo ships were the most common type within Phase 1 comprising 37% and 34% of traffic, respectively. Other ships (mainly offshore vessels) made up 14% of traffic; followed by fishing vessels contributing 12%.

4.3 *Ship Length and Draught Information*

Based on the information available from AIS, the tracks colour-coded by length and draught (where available) are presented in Figure 4.6 and Figure 4.8**.**

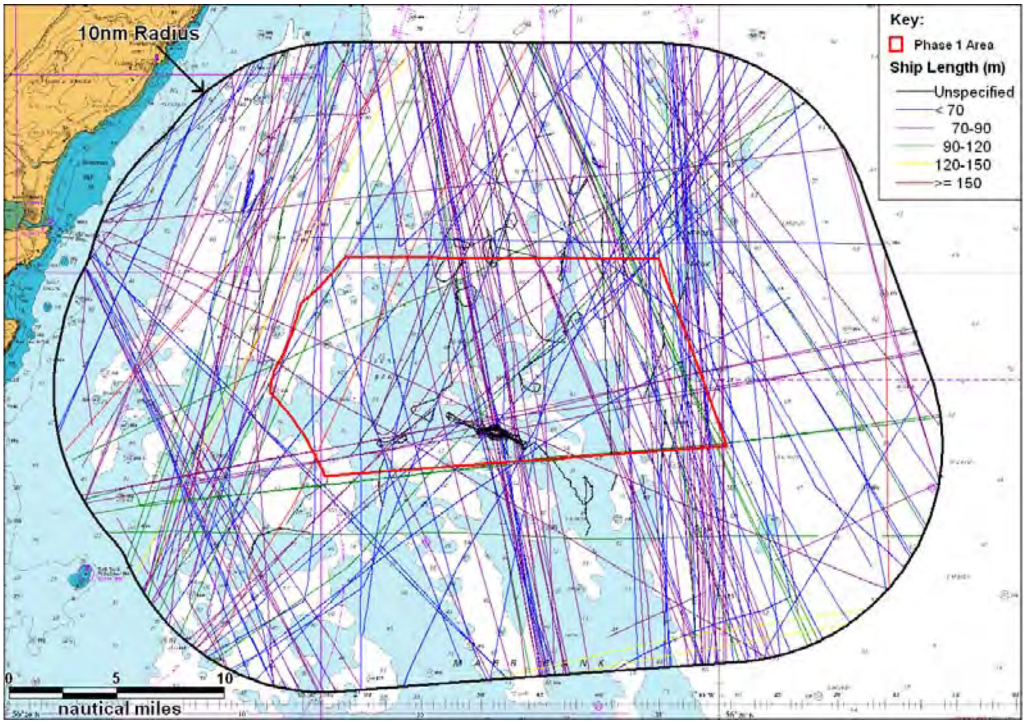


Figure 4.6 Combined Survey Data by Ship Length within 10nm of Phase 1

The average length of vessels passing within Phase 1 during the survey was 82m.

The longest vessel recorded intersecting Phase 1 was the crude oil tanker *Sea Lady* at 239m, recorded on one day of the survey headed to Hound Point. This vessel is 42m wide at the beam and broadcast a draught of 7.5m.

The track of *Sea Lady* recorded during the March 2011 survey is presented Figure 4.7.

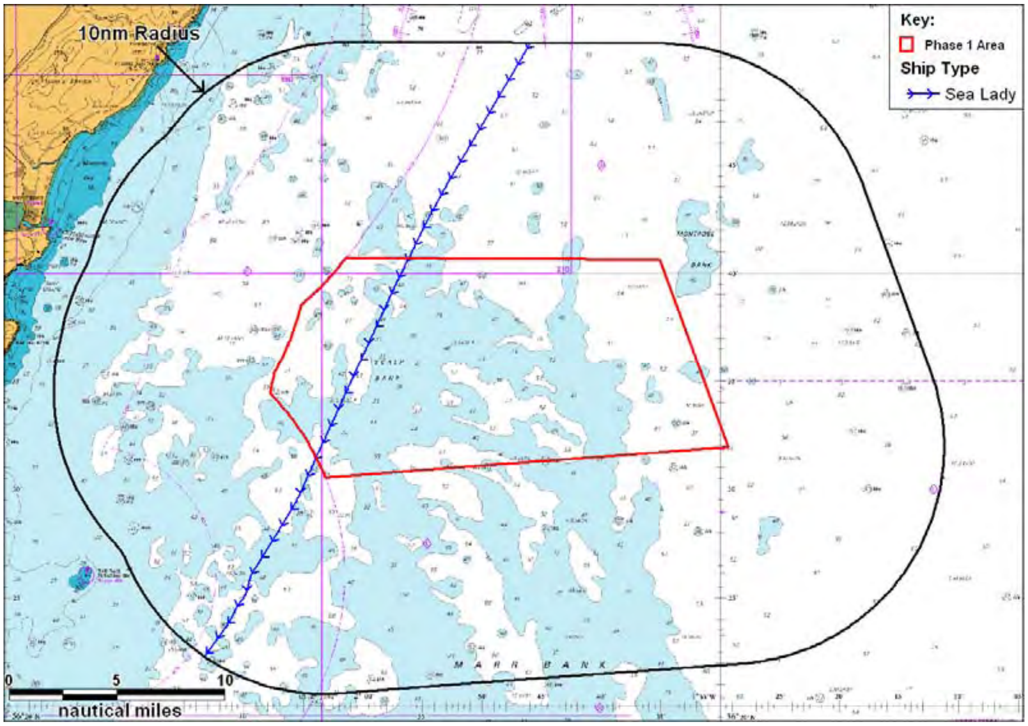


Figure 4.7 AIS Track of the Largest ship Tracked *Sea Lady* (18 March 2011)

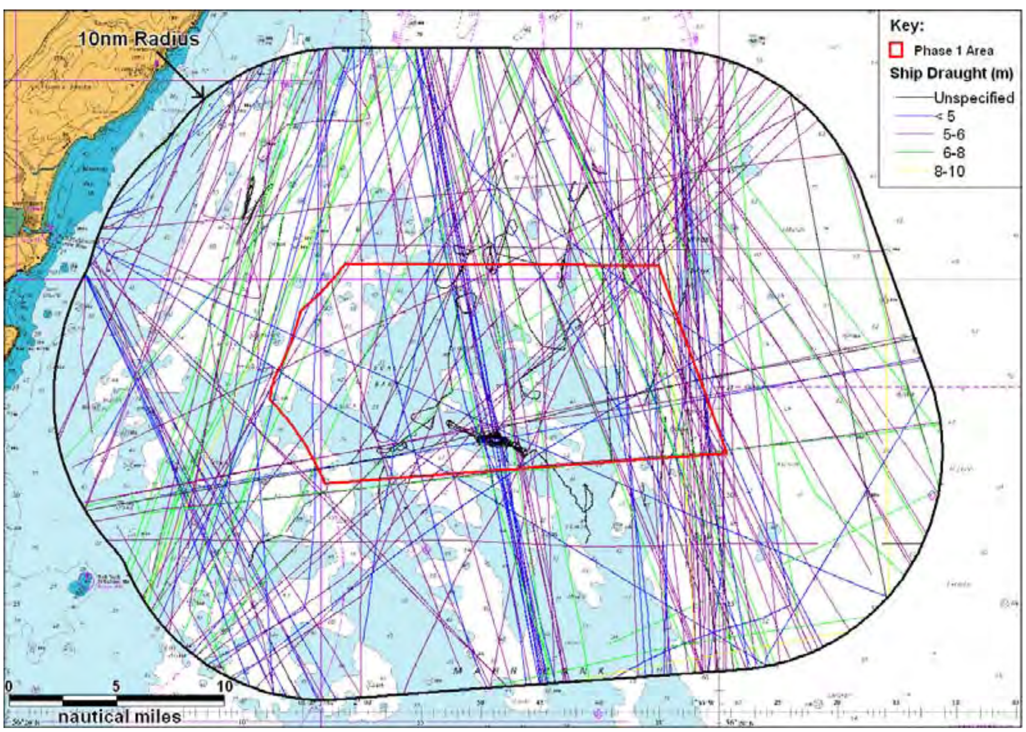


Figure 4.8 Combined Survey Data by Ship Draught within 10nm of Phase 1

The average draught of vessels which passed within Phase 1 during the March 2011 survey was 4.4m.

The deepest draught vessel was *Arklow Marsh* recorded on one day of the survey headed to Blyth. This is a 14,056 DWT general cargo ship, with draught broadcast at 8.5m.

The tracks of *Arklow Marsh* recorded during March 2011 are presented in Figure 4.9.

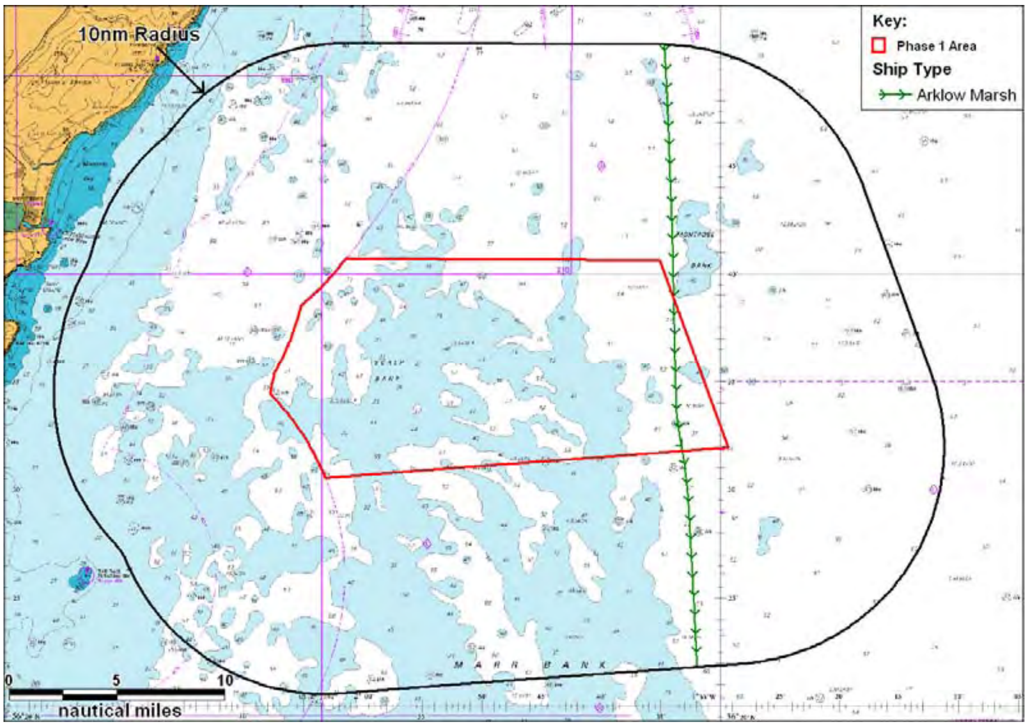


Figure 4.9 AIS Track of the Deepest Draught ship Tracked *Arklow Marsh* (19 March 2011)

4.4 *Speed Distribution*

The speed distribution of the vessels tracked within Phase 1 is summarised in Figure 4.10.

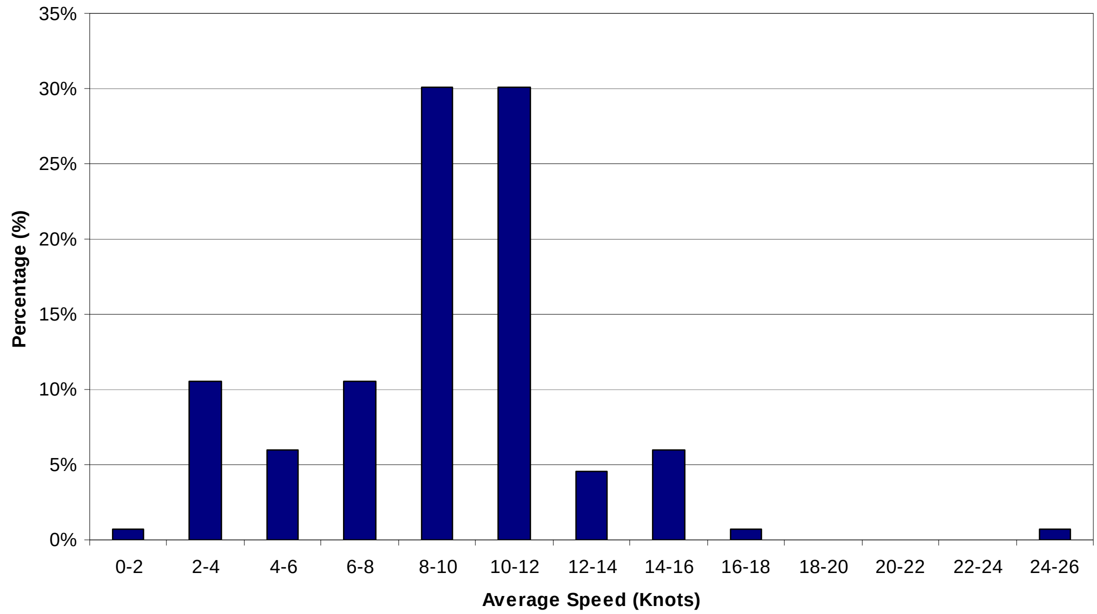


Figure 4.10 Speed Distribution of Vessels Passing within Phase 1

The average speed was 9.2 knots. The fastest vessel tracked within Phase 1 was the offshore wind farm support vessel *Porth Dinllaen* travelling at an average speed of 18 knots headed southbound to Eyemouth.

Approximately half of vessels with an average speed under six knots were fishing vessel tracks (11 out of 23). Visual observations during the survey identified one regular Scallop Dredger (non-AIS) operating within Phase ; attempts to identify this vessel over VHF radio were unsuccessful.

4.5 *Average Course*

The tracks colour coded by average course, are presented in Figure 4.11.

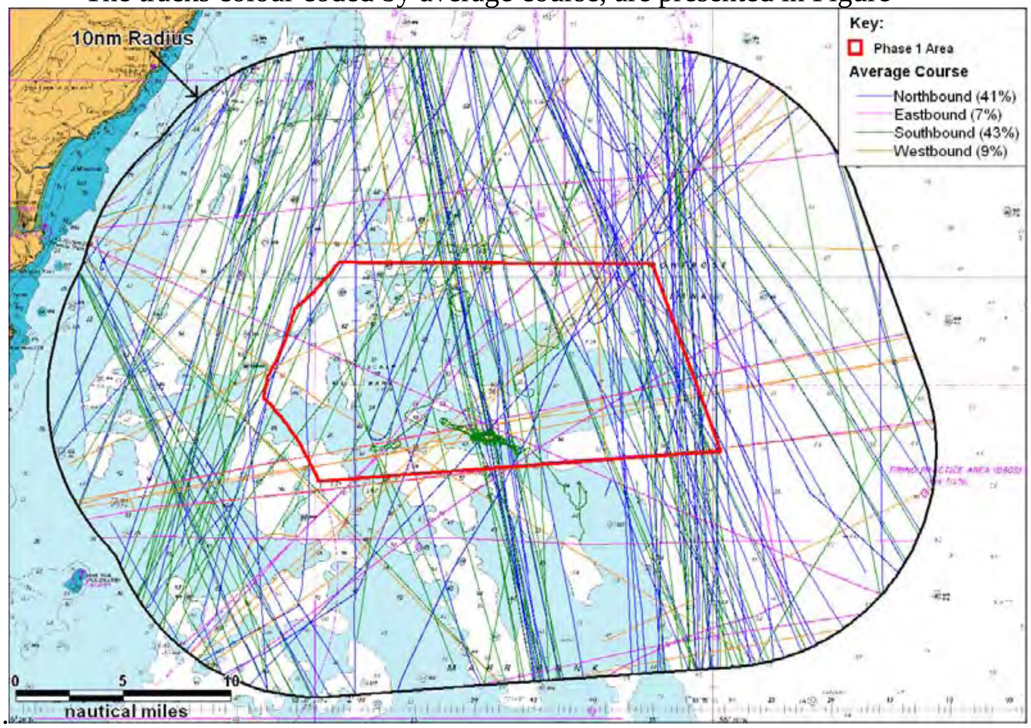


Figure 4.11 Combined Survey Data by Average Course within 10nm of Phase 1

The average course of the traffic intersecting Phase 1 was split with the majority of vesselsheading northbound (41%) and (43%) southbound.

4.6 *Destinations*

The destinations of vessels tracked within Phase 1 are summarised in Figure 4.12.

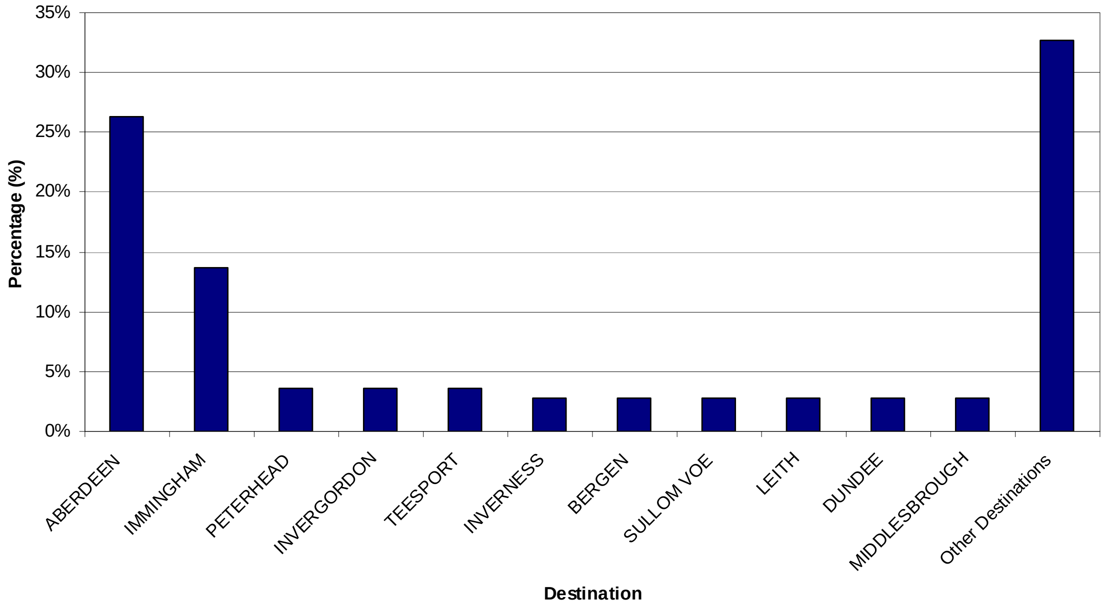


Figure 4.12 Main Destination Ports of Vessels Passing through Phase 1

It can be seen that the main regular destinations were Aberdeen (26%) and Immingham (14%). Other common destinations included North Eastern Scottish and English ports (Peterhead, Invergordon and Teesport).

One third of vessels tracked (33%) were recorded headed to various other destinations in the UK (Forth 5% and Humber ports 5%), Scandinavian (3%) and mainland Europe (4%). It is noted that no vessels intersecting Phase 1 were recorded headed to ports outside Europe.

4.7 *Anchored Vessels*

Anchored vessels were identified based on AIS navigational status which is set on the AIS unit onboard a vessel. Information is manually inputted into the AIS transponder; therefore it is common for ships not to update the navigational status if they are anchored for only a short period of time. Subsequently, the data was analysed for vessels with low speeds or ship tracks which showed signs of anchoring.

The vessels that broadcast their navigation status as 'at anchor' during the survey were to the west of Phase 1 off Montrose. Figure 4.13 shows the two vessels anchored relative to Phase 1.

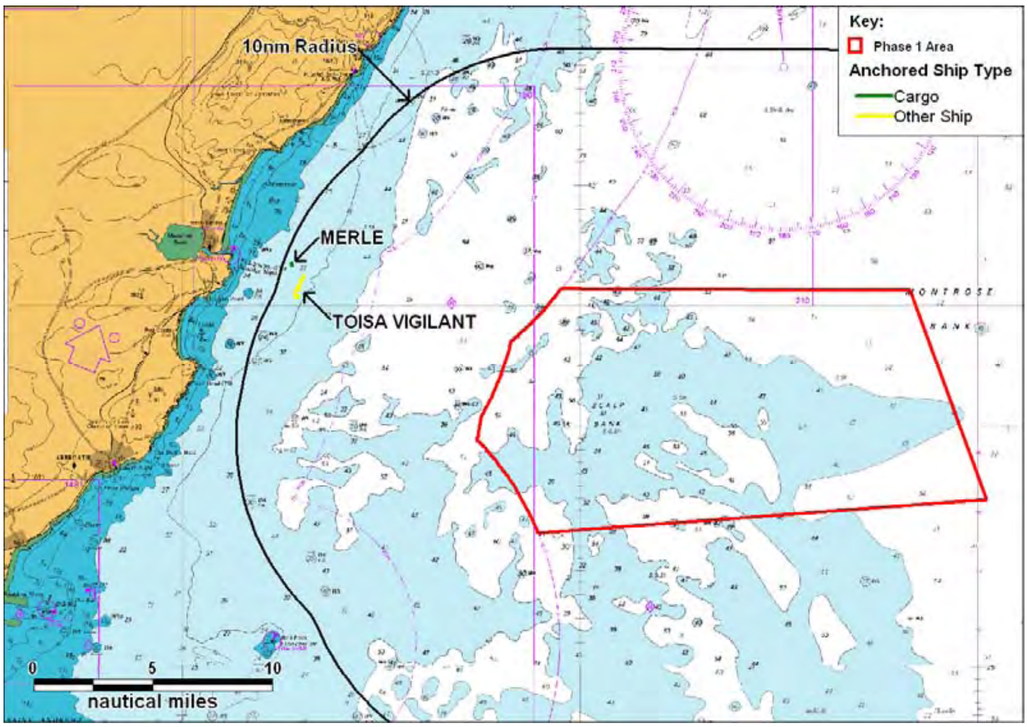


Figure 4.13 Anchored Vessels Recorded within 10nm of Phase 1

The offshore supply vessel *Toisa Vigilant* was the closest anchored vessel relative to Phase 1, approximately 9nm to the west. This vessel was anchored on 22nd March before heading into Montrose on the 23rd March.

The other anchored vessel was the general cargo vessel *Merle* located 9.7nm west of Phase 1. This vessel was anchored on the 17th and 18th March before heading into Montrose.

E5. Review of Survey Data by Vessel Type

This section presents more detailed analysis of the survey data by vessel type.

5.1 *Cargo Vessels*

The cargo vessels tracked within 10nm of Phase 1 are shown in Figure 5.1.

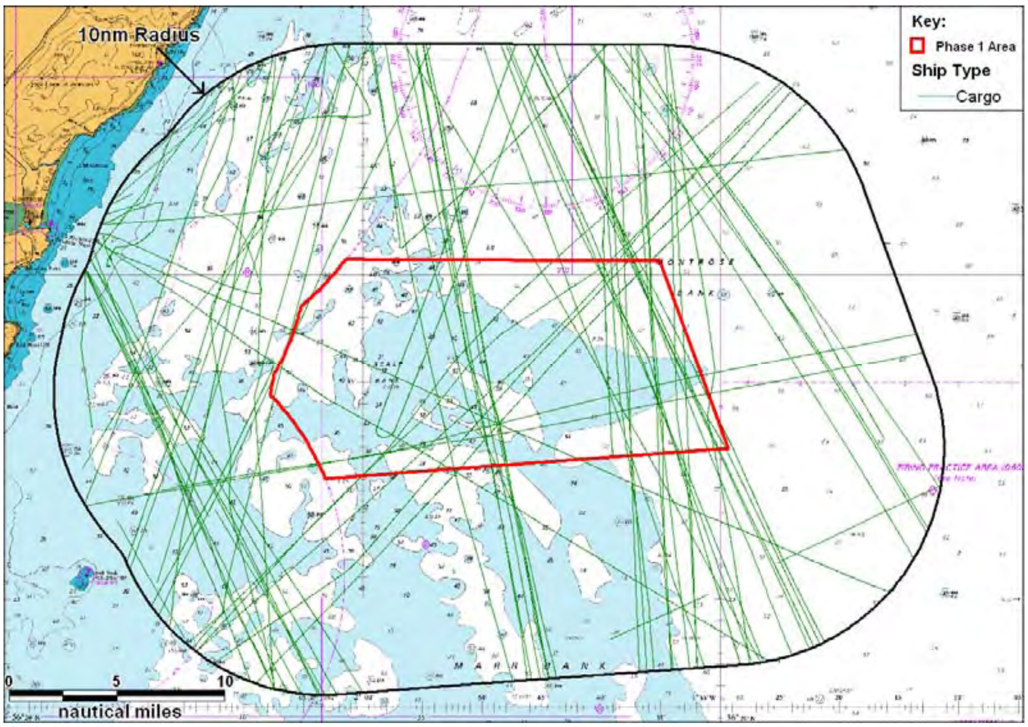


Figure 5.1 Cargo Vessels Recorded within 10nm of Phase 1

Cargo ships were the most common type within 10nm of Phase 1, with the majority headed north/south bound. An average of 3 cargo vessel per day passed through Phase 1 during the survey.

5.2 *Tankers*

Figure 5.2 presents a chart overview of the tankers recorded intersecting Phase 1 during the survey.

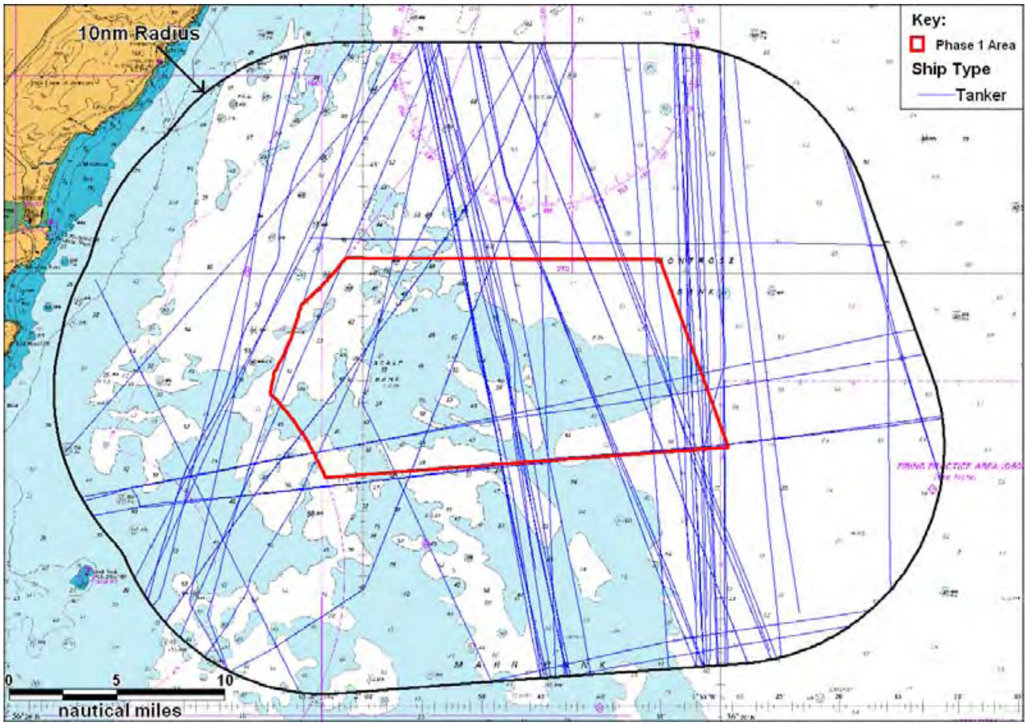


Figure 5.2 Tankers Recorded within 10nm of Phase 1

Tankers were the second most common vessel type within 10nm of Phase 1, taking similar routes to cargo vessels. However there were a higher number of tankers intersecting Phase 1 compared to cargo vessels with approximately 4 tankers per day.

5.3 *Fishing Vessels*

Figure 5.3 presents a chart overview of the fishing vessels recorded intersecting Phase 1 during the survey.

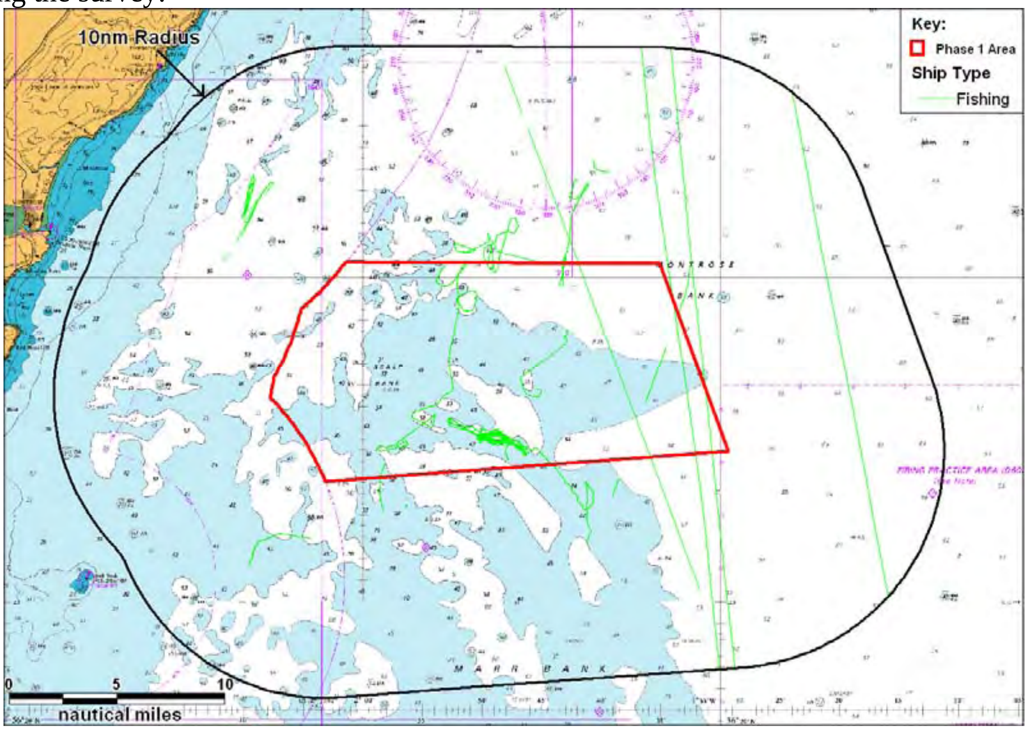


Figure 5.3 Fishing Vessels Recorded within 10nm of Phase 1

An average of less than 1 fishing vessel per day was recorded within Phase 1 during the survey. The fishing vessel tracked most frequently in the vicinity of Phase 1 (radar and AIS) was the scallop dredger *Calisha PD235* recorded on two days of the survey operating 4.5nm north west of Phase 1.

The most active fishing vessel within Phase 1 was an unidentified Scallop Dredger recorded on radar (non-AIS) present on 3 days of the survey.

5.4 *Other Vessels*

Figure 5.4 presents a chart overview of the other ships category recorded during the survey.

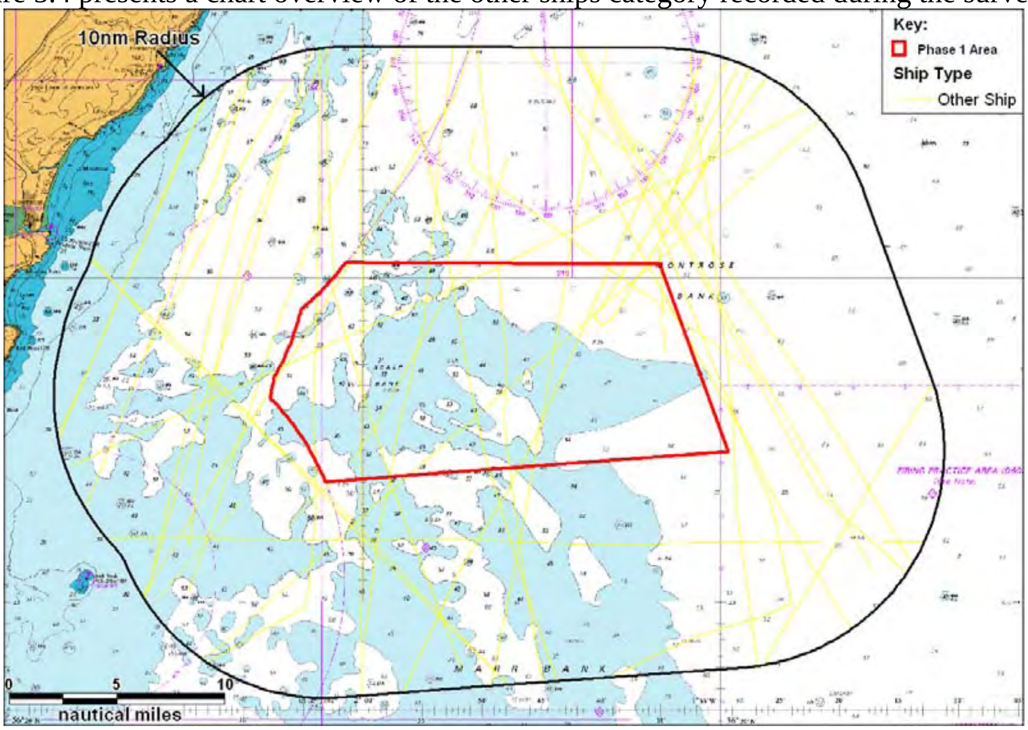


Figure 5.4 Other Ships Recorded within 10nm of Phase 1

An average of 1 other vessel per day was recorded within Phase 1 during the survey. The majority of other ships were offshore supply/support vessels (75%) headed between Aberdeen and North Sea installations.

The most active offshore vessel within Phase 1 was the offshore supply vessel *Cassandra 5* recorded on 2 days of the survey, headed south west into the Forth on 15th March and headed northbound on the 16th March.

5.5 *Hazardous Cargo Type*

In AIS data the hazardous cargo type is based on four classifications (A to D) with hazardous cargo type A being defined as the most harmful. Vessels voluntarily record the harmfulness to the marine environment of the cargo carried, defined by the following dangerous goods types:

- Carrying Dangerous Goods (DG);
- Harmful Substances (HS);
- Marine Pollutants (MP).

The hazardous cargo type as defined by International Maritime Dangerous Goods (IMDG) Code broadcast on AIS (where available) is presented in Figure 5.5.

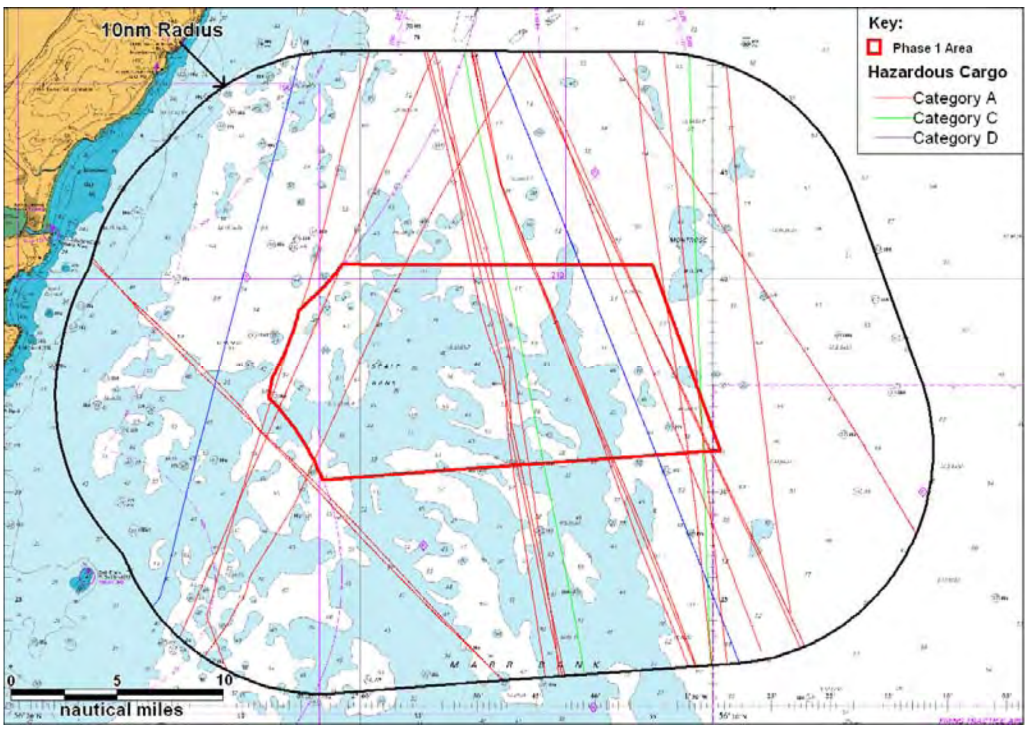


Figure 5.5 Hazardous Cargo Vessels Recorded within 10nm of Phase 1

An average of 1-2 (1.5) vessels per day with hazardous cargoes were recorded intersecting Phase 1 during the survey. The majority of vessels carrying hazardous cargo were Products Tankers headed between Aberdeen and Immingham.

The most active vessels with hazardous cargo intersecting Phase 1 were *Aspirity*, *Audacity*, *UAL America* and *Speciality* each with two transits.

E6. Phase-Specific Analysis

6.1 *CPA Analysis*

A detailed analysis of shipping passing within 5nm of Phase 1 was carried out to assess the distribution of closest passing distances during the survey. The minimum passing distance of ships passing within 5nm of Phase 1 is presented in Figure 6.1.

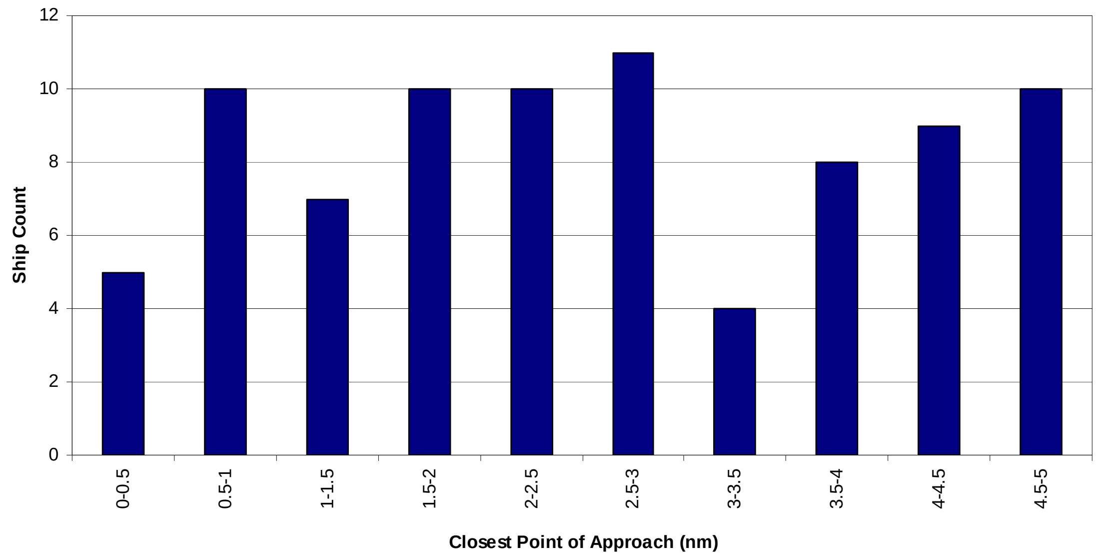


Figure 6.1 CPA Distribution of Tracks passing within 5nm of Phase 1

Five vessels were recorded passing within 0.5nm and ten vessels passed between 0.5-1nm of Phase 1 during the survey period (14 days).

6.2 *Summary of Intersecting Vessels*

A summary of the vessels that crossed Phase 1 on more than one occasion and the number of times they crossed the area are presented in Table 6.1. Note that when a vessel left the zone and then re-entered very soon after, these have been counted as a single crossing.

Table 6.1 Vessels Intersecting Phase 1 (at least one crossing)

Ship Name	Type	Ship Manager	Crossings
Clipper Burgundy	Chemical/Products Tanker	Nordic Tankers Marine A/S	4
Thames Fisher	Products Tanker	James Fisher Shipping Services	3
Victress	General Cargo Ship	Faversham Ships Ltd	3
Asperity	Products Tanker	James Fisher Shipping Services	2
Audacity	Products Tanker	James Fisher Shipping Services	2
Birch	General Cargo Ship	VW Nyki Shipping	2
Bro Goliath	Chemical/Products Tanker	Brostrom Ship Management AB	2
Gripfisk	Fish Carrier	Remoy H	2
MT Orastar	Chemical Tanker	Gullfonn Management	2
Ronez	Cement Carrier	World Self Unloaders Ltd	2
Shannon Fisher	Products Tanker	James Fisher Shipping Services	2
Solway Fisher	Products Tanker	James Fisher Shipping Services	2
Speciality	Products Tanker	James Fisher Shipping Services	2
Transmar	General Cargo Ship	Held Bereederungs GmbH & Co KG	2
UAL Africa	General Cargo Ship	Carisbrooke Shipping Mgmt GmbH	2
UAL America	General Cargo Ship	Carisbrooke Shipping Mgmt GmbH	2
Vedrey Hallarna	Chemical/Products Tanker	V Ships UK Ltd	2
VOS Raasay	Offshore Support	Vroon Offshore Services	2
Whitstar	Products Tanker	Whitaker Tankers Ltd	2
Willeke	General Cargo Ship	Wagenborg Shipping BV	2

The Chemical/Products tanker *Clipper Burgundy* was the most frequently recorded vessel passing through Phase 1 with 4 crossings during the survey period.

E7. Conclusions

This report has provided an analysis of the winter AIS and radar shipping tracks recorded for the first 14 days of surveying in Phase 1 within the Firth of Forth Zone.

Overall, the survey achieved the aims to gather data on a range of vessel types over 14 days during winter 2011. The second 14 days of surveying is planned during summer 2011 to allow for seasonable variations.

Highland Eagle Maritime Traffic Survey Report

Phase 1

(Appendix F)

Prepared by:	Anatec Limited
Presented to:	Seagreen
Date:	5th September 2011
Revision No.:	01
Ref.:	A2520-SEA-NRA-1 App F

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TABLE OF CONTENTS

F1. Introduction

1.1 *Background*

This report presents analysis of a 26 day shipping traffic survey which has been carried out from the *Highland Eagle* offshore vessel during June and July 2011(20th June to 21st July). The data was collected using radar, AIS and visual observations.

The survey validates findings from the winter survey carried out in March 2011(Ref. i) and serves to cover seasonal fluctuations in shipping and navigational activity.

1.2 *Abbreviations*

The following abbreviations are used throughout the report:

AIS	-	Automatic Identification System
ARPA	-	Automatic Radar Plotting Aid
CPA	-	Closest Point of Approach
DWT	-	Dead Weight Tonnage
FTOWDG	-	Firth and Tay Offshore Wind Developers Group
IMO	-	International Maritime Organisation
MCA	-	Marine Coastguard Agency
MGN	-	Marine Guidance Note
MMSI	-	Mobile Maritime Service Identity
nm	-	Nautical Miles (1nm = 1,852 metres)
NRA	-	Navigational Risk Assessment
SOLAS	-	Safety of Life at Sea
VHF	-	Very High Frequency
UTC	-	Coordinated Universal Time (equivalent to GMT)

F2. Survey Set-up

2.1 *Introduction*

A maritime traffic survey of the Forth Round 3 Phase 1 area was carried out from the *Highland Eagle* offshore support/drilling vessel (Figure 2.1). The objective of the survey was to collect data on vessel movements in the area during the summer period and to collect further shipping data for the NRA.

A library image of the survey vessel is presented below.

Figure 2.1 Library Picture of the Vessel *Highland Eagle*

The primary objective of the survey was to identify the routeing of vessels in and around Phase 1 in the Firth of Forth Round 3 zone, and to supplement the 14 days of winter survey data collected in March 2011.

This was achieved by recording in real-time the positions of vessels within range of the Automatic Identification System (AIS) receiver and Automatic Radar Plotting Aid (ARPA) radar as well as being supplemented by observation of vessels within visual range to obtain information on type and size where the information was not available from AIS.

2.2 *Survey Location*

An overview and detailed chart of the Phase 1 area, within the northern section of the Forth Round 3 zone is presented in Figure 2.2 and Figure 2.3.

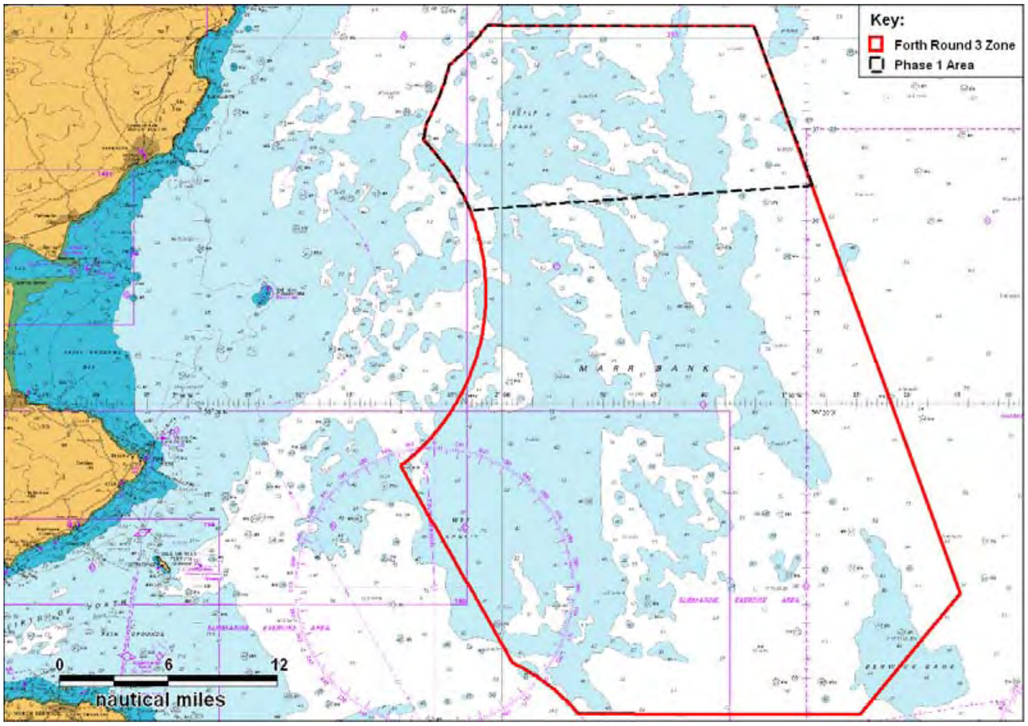


Figure 2.2 Chart Overview of the Phase 1 Area and Round 3 Zone

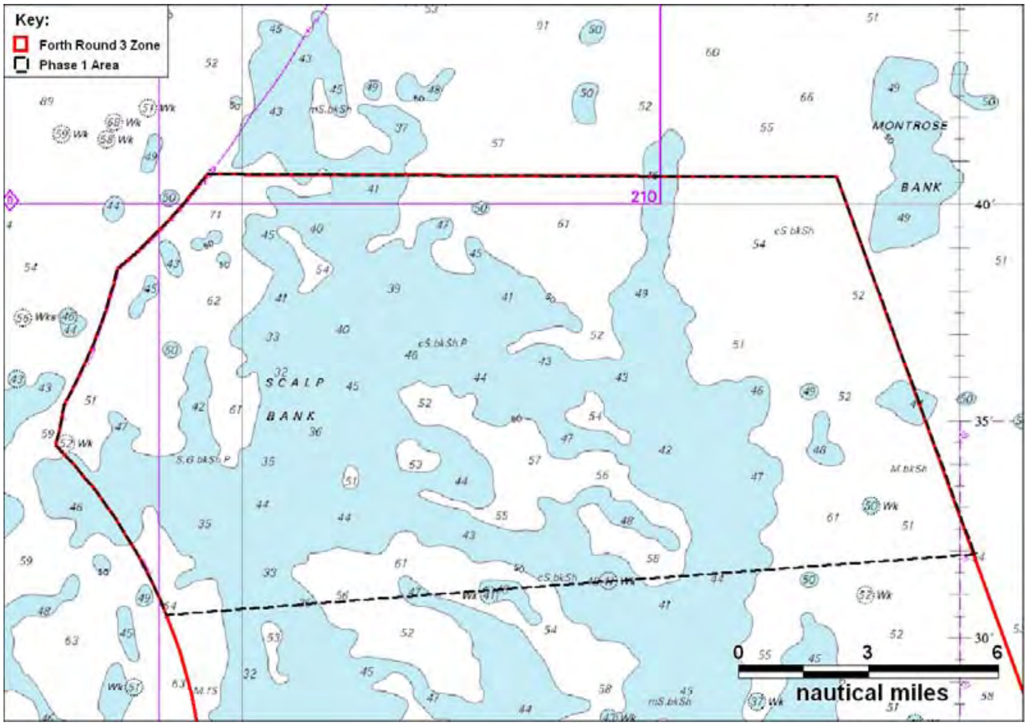


Figure 2.3 Detailed Overview of the Phase 1 Area

Figure 2.4 presents a detailed overview of Phase 1 and the tracks of the survey vessel *Highland Eagle* during the survey.

2.3 *Survey Vessel Movements*

From the *Highland Eagle* AIS pline/track, the vessel was on site and commenced the survey on Monday 20th June 2011 and departed the site at 18:00 Hours on Tuesday 21st June before returning to survey for the period 23rd to 29th June (the vessel left at 09:00 Hours to crew change in Aberdeen).

Following the crew change the vessel was on site from the 1st July to 20:00 Hours on the 10th July and then returned for 3 Hours on the 12th July to complete the surveying at 15:00 Hours on the 21st July. It is noted that in total coverage of the survey area was achieved for 26 days and 17 Hours.

Figure 2.4 presents the *Highland Eagle* tracks for the duration of the survey period, whilst conducting a geotechnical survey.

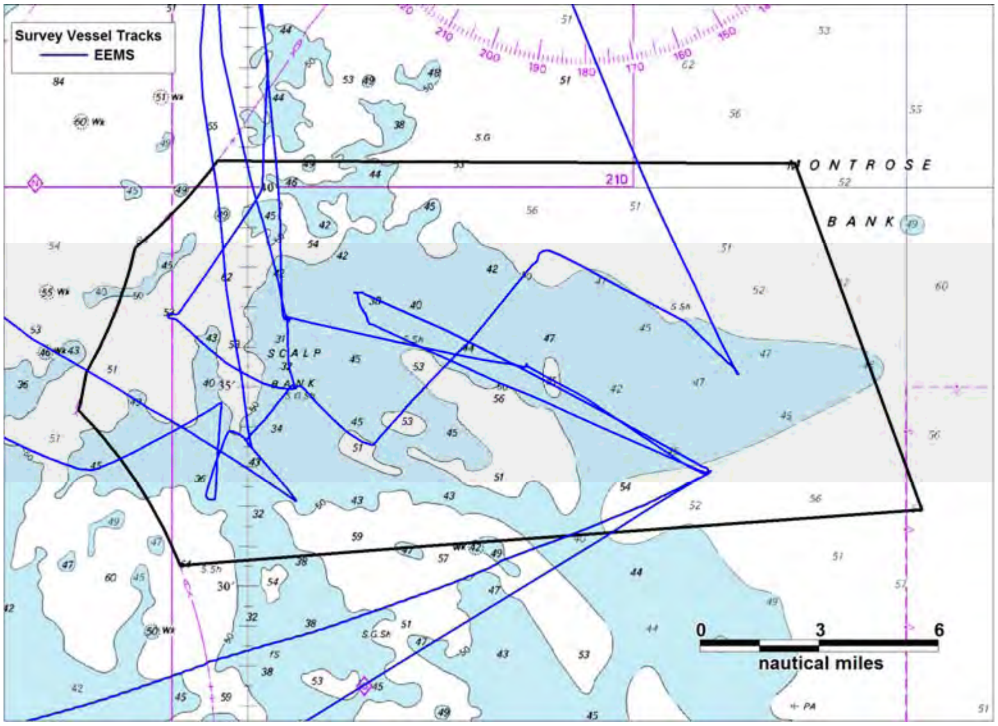


Figure 2.4 Chart Overview of Phase 1 and Survey Vessel Tracks

2.4 *Equipment and Manning*

Table 2.1 lists the equipment used to carry out the traffic survey.

Table 2.1 Equipment utilised in Traffic Survey

Equipment	Purpose
Radar: Furuno FAR 2835 S	Tracking of non-AIS targets (manually and automatically)
AIS: Furuno FA-100 UAIS Transponder	To receive and record data from vessels transmitting AIS data.
Nautical Compass	Used to verify bearing of vessels.
Binoculars	Visual identification of vessels.
Digital Camera	Photographic evidence of targets (when possible)
Notebook PCs	Connected to radar and AIS receiver for real-time recording of tracked target data. Tracked targets displayed on hydrographic charts.
Logbook	Written log of all manual targets acquired during survey as well as other notes such as visual identification information, weather conditions, etc.

The survey was conducted 24 Hours per day when the vessel was on site. The AIS and Radar systems tracked targets 24 Hours per day during the survey period. During the survey a visual lookout was maintained and all observations were recorded in the logbook.

For the majority of time radar observations were made within 6-12nm range which facilitated the tracking of all vessels passing through the Phase 1 area. The radar range varied based on conditions and target details but typically vessels were tracked up to 12nm from the survey vessel and some targets beyond 14nm. However, it is noted small and/or high speed targets were sometimes not picked-up/acquired on radar at first sighting.

The AIS system automatically tracked all targets within range, which again varied depending on conditions, but was typically at least 20nm. It is also noted that occasionally smaller vessels including sailing yachts and small fishing boats that are not mandatorily required to carry AIS may install a less expensive, lower power version called Class B AIS. Occasionally these vessels can be dropped off / picked up when at the edge of recordable range, i.e. 10-15nm.

2.5 *AIS Description*

Regulation 19 of SOLAS Chapter V - Carriage requirements for ship borne navigational systems and equipment - sets out navigational equipment to be carried on board ships, according to ship type. In 2000, IMO adopted a new requirement (as part of a revised new chapter V) for ships to carry automatic identification systems (AIS). AIS is a system by which ships transmit data concerning their position, MMSI etc on two individual VHF channels to the shore and other vessels, at very frequent intervals. The data is transmitted automatically via VHF to other vessels and coastal stations/authorities.

The regulation requires AIS to be fitted aboard 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 passenger ships irrespective of size built on or after 1 July 2002. It also applies to ships engaged on international voyages constructed before 1 July 2002, according to the following timetable:

- passenger ships, not later than 1 July 2003;
- tankers, not later than the first survey for safety equipment on or after 1 July 2003;
- ships, other than passenger ships and tankers, of 50,000 gross tonnage and upwards, not later than 1 July 2004.

An amendment adopted by the Diplomatic Conference on Maritime Security in December 2002 states that ships, other than passenger ships and tankers, of 300 gross tonnage and upwards but less than 50,000 gross tonnage, will be required to fit AIS not later than the first safety equipment survey after 1 July 2004 or by 31 December 2004, whichever occurs earlier. Ships fitted with AIS shall maintain AIS in operation at all times except where international agreements, rules or standards provide for the protection of navigational information.

The regulation requires that AIS shall:

- provide 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;
- receive automatically such information from similarly fitted ships; exchange data with shore-based facilities.

Both dynamic and static information are transmitted by the vessel. Table 2.2 presents the dynamic and static data provided via AIS.

Table 2.2 AIS Information

Static	Dynamic	Voyage related
MMSI	Position (Lat/Long)	Draught
IMO Number	Time	Hazardous Cargo (type)
Call Sign	Course over ground	Destination
Name	Speed over ground	ETA
Length and Beam	Heading	Route Plan
Type of Ship	Navigational Status	
Type of Nav Sensor	Rate of Turn	

2.6 *Weather Data*

The weather was recorded in a logbook 4 times per day during the survey and this is presented in Table 2.3.

The wind direction was split approximately evenly from south to south west and north to north east direction during the survey.

The wind speed for the survey was generally Force 3 to 4 on the Beaufort scale, with less than four days experiencing a Force 5 or more. The maximum wind speed was recorded 7th July when there was a Force 6-7 and a moderate sea state.

Table 2.3 Weather Log for Phase 1 Survey (14 Days)

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
20th June	08:00	W-NW	0 to 1	Flat Calm	9	Overcast + Slight Haze
	12:00	W-NW	0 to 1	Flat Calm	9	Overcast + Slight Haze
	16:00	S-SE	1 to 2	Flat Calm	11	Sunny Clear
	20:00	SE	1 to 2	Calm	8	Sunny Clear
21st June	08:00	E	4	Slight/Moderate	6	Cloud Rain
	12:00	E	4	Slight/Moderate	6 to 7	Cloud Rain
	16:00	E	5 to 6	Moderate	6	Full Cloud Cover
	20:00	NE	5	Moderate	2 to 3	Low Cloud, Heavy Rain
23rd June	08:00	W	1	Calm Slight	11	Patchy Cloudy Sun
	12:00	W	1	Calm Slight	11	Patchy Cloudy Sun
	16:00	W	1	Slight	9	Residual Swell, Clear
	20:00	W	1	Slight Swell	10	Sun, Calm but 2m Long Swell
24th June	08:00	NW	1	Calm Swell	11	Sun Calm
	12:00	NW	1	Calm Swell	11	Calm
	16:00	S	5	Moderate	10	Hazy Sunshine
	20:00	S	4	Calm Slight	8	Hazy

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
25th June	08:00	S-SW	3	Slight	11	Sun + Clear
	12:00	S-SW	3	Slight	11	Sun + Clear
	16:00	S	3	Calm Slight	9	Slight Haze
	20:00	S	2	Calm	8	Sun Haze
26th June	08:00	S	4	Calm	10	Overcast
	12:00	S	4	Calm	10	Overcast
	16:00	S	4	Calm	9	Sunny + Slight + Haze
	20:00	S	3	Calm	6	Overcast + Haze
27th June	08:00	NE	2	Calm	6	Overcast
	12:00	NE	4	Calm	8	Overcast
	16:00	NE	4	Slight/Moderate	6	Overcast
	20:00	N-NE	4	Slight	6	Overcast + Rain
28th June	08:00	E	0 to 1	Flat Calm	8	Patchy Cloudy
	12:00	E	0 to 1	Flat Calm	10	Sun/Patchy Cloudy
	16:00	E	0 to 1	Flat Calm	11	Sun/Clear
	20:00	E	0 to 1	Flat Calm	10	Sun/Clear
	08:00	S	0	Flat Calm	11	Sunny/Clear

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
1st July	12:00	SW	0	Flat Calm	11	Sunny/Clear
	16:00	SW	0	Flat Calm	11	Sunny/Clear
	20:00	SE	0 to 1	Flat Calm	10	Sunny/Clear
2nd July	08:00	E	0 to 1	Flat Calm	11	Sunny/Clear
	12:00	E-SE	0 to 1	Flat Calm	11	Sunny/Clear
	16:00	NE	0 to 1	Calm	11	Sunny/Clear + Swell
	20:00	NE	1 to 2	Calm	11	Sunny/Clear + Swell
3rd July	08:00	NE	0 to 1	Calm	11	Sunny/Clear + Swell
	12:00	NE	2	Calm	11	Sunny/Clear + Swell
	16:00	NE	2	Calm	11	Sunny/Clear + Swell
	20:00	NE	2	Calm	11	Sunny/Clear + Swell
4th July	08:00	SE	2 to 3	Calm	11	Sunny/Clear + Swell
	12:00	SE	2 to 3	Calm	11	Sunny/Clear, No Swell
	16:00	SE	4	Slight	11	Sunny/Clear, No Swell
	20:00	SE	4 to 5	Slight/Moderate	8	Overcast
5th July	08:00	SE	6	Moderate	8 to 10	Overcast
	12:00	SE	6	Moderate	8	Overcast

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
	16:00	SE	6	Moderate	5 to 6	Overcast + Low Cloud
	20:00	SE	6	Moderate	5	Overcast + Low Cloud
6th July	08:00	E	4	Moderate	<1	Low Cloud, Heavy Rain
	12:00	E	4 to 5	Moderate	<1	Low Cloud, Heavy Rain
	16:00	W	2 to 3	Moderate	6 to 7	Cloud, Rain
	20:00	S	4	Moderate	10	Sun + Part Cloudy
7th July	08:00	SE	6	Moderate	8 to 10	Sun + Part Cloudy
	12:00	SE	6 to 7	Moderate	8 to 10	Sun + Part Cloudy
	16:00	SE	6	Moderate	8	Overcast Grey
	20:00	SE	4	Moderate	8	Part Cloudy
8th July	08:00	SE	4	Calm	11	Sunny
	12:00	SE	2	Flat Calm	11	Sunny
	16:00	SE	2	Flat Calm	11	Sunny
	20:00	SE	1 to 2	Flat Calm	11	Sunny
9th July	08:00	N	2	Calm	5 to 8	Cloud Light Rain
	12:00	N	2	Calm	5 to 8	Cloud Rain/ Variable Visibility
	16:00	N	1 to 2	Calm	10	Cloud
	20:00	NW	3	Calm/Slight	5 to 8	Cloud Rain /Variable Visibility

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
10th July	08:00	S-SW	0	Flat Calm	11	Sunny Clear
	12:00	E	0	Flat Calm	9 to 11	Sunny + Slight Haze
	16:00	E	1	Flat Calm	10	Overcast
	20:00	E	2	Calm	8 to 10	Overcast
13th July	08:00	N	1 to 2	Calm/Slight	11	Sunny Cloudless
	12:00	N	1 to 2	Calm/Slight	11	Sunshine
	16:00	N	1 to 2	Calm/Swell	11	Sunny/Swell
	20:00	N	1	Calm/Swell	11	Sunny/Swell
14th July	08:00	S	1	Calm/Swell	11	Sunny + Slight Swell
	12:00	S	1	Calm/Swell	11	Sunny + Slight Swell
	16:00	S	1 to 2	Calm	11	Sunny + Slight Swell
	20:00	S	3	Calm	11	Sunny + Part Cloud
15th July	08:00	S	2 to 3	Slight	11	Sunny
	12:00	S	2 to 3	Calm/Slight	11	Sunny
	16:00	S	4	Slight	11	Sunny
	20:00	S-SW	5 to 6	Moderate	8	Cloud + Rain
16th	08:00	S	6	Moderate/Rough	4	Cloud Rain/ Poor Visibility
	12:00	S	6	Moderate/Rough	4	Cloud Rain/ Poor Visibility

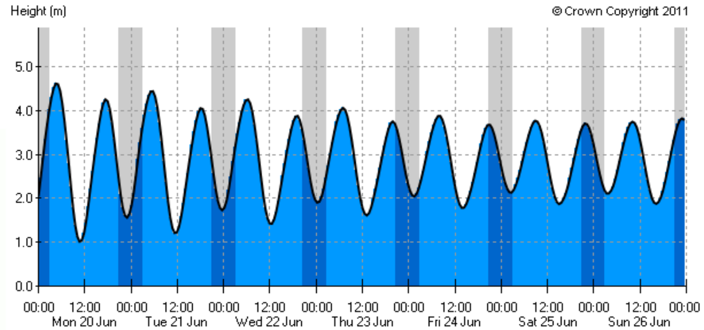
Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
July	16:00	SE	3	Moderate	4 to 6	Cloud / Poor Visibility
	20:00	N-NE	2	Moderate	4	Cloud Rain/ Poor Visibility
17th July	08:00	N	1	Calm	11	Patchy Cloudy
	12:00	N	0	Flat/Calm	11	Patchy Cloudy
	16:00	NE	3	Slight	8 to 10	Good Visibility in Sun/Poor in Rain
	20:00	N	4	Slight	8 to10	Poor Visibility in Rain
18th July	08:00	N	5	Moderate	8 to 10	Sun + Patchy Cloud
	12:00	N	5	Moderate	8 to 10	Sun + Patchy Cloud
	16:00	N	5	Moderate	8	Overcast
	20:00	N	4 to 5	Moderate	8	Overcast
19th July	08:00	N	2	Slight	8 to 10	Overcast + Rain
	12:00	N	1 to 2	Slight	8 to 10	Overcast +Heavy Rain
	16:00	N	2	Slight	8 to 10	Overcast
	20:00	N	2	Slight	8 to 10	Overcast
20th July	08:00	N	2	Slight	8 to 10	Overcast
	12:00	N	2	Slight	11	Sun/Part Cloudy
	16:00	N	4	Slight	11	Sun/Part Cloud Swell
	20:00	N	5	Slight/Moderate	11	Part Cloudy Swell

Date	Time	Wind Direction	Beaufort Wind Scale	Sea State	Visibility (nm)	Comments
21st July	08:00	N	3	Slight/Moderate	11	Sunny
	12:00	N	3	Slight/Moderate	11	Sunny
	16:00	N	4	Moderate	11	Sun/Part Cloud
	20:00	Not on site	Not on site	Not on site	Not on site	Not on site

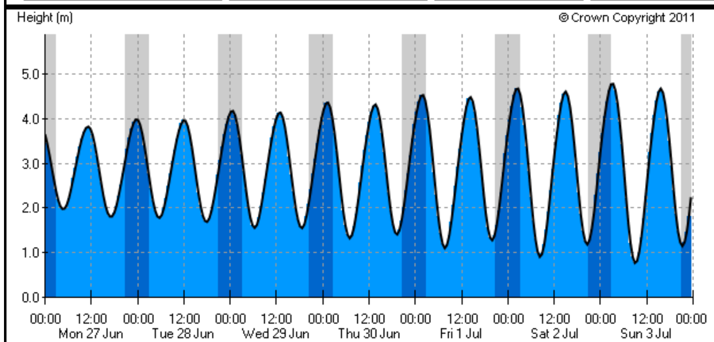
2.7 *Tidal Data*

Tidal data for the area has been taken from Montrose, approximately 13nm to the west of Phase 1, and is presented in Figure 2.5 to Figure 2.7 (overleaf).

A range of tidal conditions were experienced during the survey period, with 3 spring and 2 neap tides. The maximum spring tide was on Sunday 3rd July when the tide ranged from 0.8m to 4.9m above chart datum, and the lowest neap tide was on Sunday 26th June when low and high waters were 2.1m and 3.8m above chart datum.

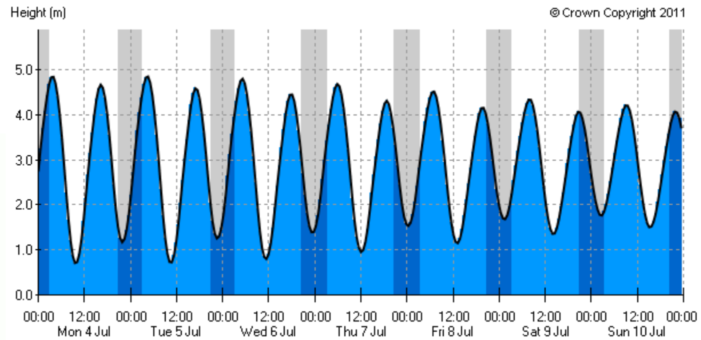


Day				
Mon 20 Jun	HW	LW	HW	LW
	04:42	10:47	17:29	22:52
	4.6 m	1.0 m	4.3 m	1.6 m
Tue 21 Jun	HW	LW	HW	LW
	05:25	11:29	18:13	23:35
	4.5 m	1.2 m	4.1 m	1.7 m
Wed 22 Jun	HW	LW	HW	
	06:09	12:14	18:59	
	4.3 m	1.4 m	3.9 m	
Thu 23 Jun	LW	HW	LW	HW
	00:23	06:59	13:03	19:50
	1.9 m	4.1 m	1.6 m	3.8 m
Fri 24 Jun	LW	HW	LW	HW
	01:19	07:53	13:58	20:47
	2.0 m	3.9 m	1.8 m	3.7 m
Sat 25 Jun	LW	HW	LW	HW
	02:24	08:55	14:59	21:50
	2.1 m	3.8 m	1.9 m	3.7 m
Sun 26 Jun	LW	HW	LW	HW
	03:33	10:03	16:03	22:53
	2.1 m	3.7 m	1.9 m	3.8 m



Day				
Mon 27 Jun	LW	HW	LW	HW
	04:40	11:09	17:03	23:46
	2.0 m	3.8 m	1.8 m	4.0 m
Tue 28 Jun	LW	HW	LW	
	05:33	12:05	17:49	
	1.8 m	4.0 m	1.7 m	
Wed 29 Jun	HW	LW	HW	LW
	00:31	06:18	12:52	18:30
	4.2 m	1.6 m	4.1 m	1.6 m
Thu 30 Jun	HW	LW	HW	LW
	01:11	06:58	13:34	19:10
	4.4 m	1.3 m	4.3 m	1.4 m
Fri 1 Jul	HW	LW	HW	LW
	01:48	07:38	14:13	19:50
	4.5 m	1.1 m	4.5 m	1.3 m
Sat 2 Jul	HW	LW	HW	LW
	02:24	08:18	14:54	20:29
	4.7 m	0.9 m	4.6 m	1.2 m
Sun 3 Jul	HW	LW	HW	LW
	03:02	09:00	15:34	21:10
	4.8 m	0.8 m	4.7 m	1.2 m

Figure 2.5 Tidal Predictions for Montrose from 20 June to 3 July 2011 (Source: Admiralty Tides, UTC Times)



Mon 4 Jul

HW	LW	HW	LW
03:40	09:43	16:17	21:51
4.9 m	0.7 m	4.7 m	1.2 m

Tue 5 Jul

HW	LW	HW	LW
04:22	10:27	17:01	22:35
4.9 m	0.7 m	4.6 m	1.3 m

Wed 6 Jul

HW	LW	HW	LW
05:05	11:14	17:48	23:22
4.8 m	0.8 m	4.5 m	1.4 m

Thu 7 Jul

HW	LW	HW
05:54	12:05	18:41
4.7 m	1.0 m	4.3 m

Fri 8 Jul

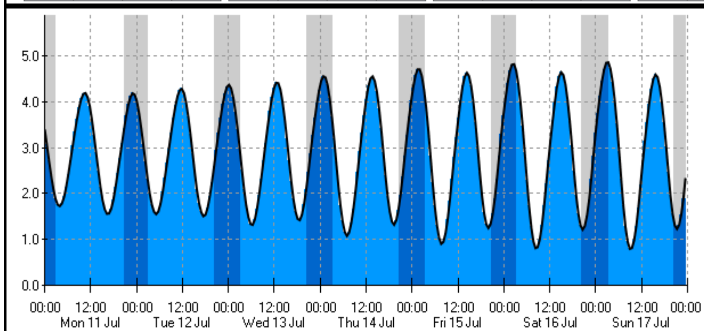
LW	HW	LW	HW
00:15	06:51	13:02	19:40
1.5 m	4.5 m	1.1 m	4.2 m

Sat 9 Jul

LW	HW	LW	HW
01:19	07:56	14:05	20:45
1.7 m	4.4 m	1.3 m	4.1 m

Sun 10 Jul

LW	HW	LW	HW
02:30	09:08	15:13	21:55
1.8 m	4.2 m	1.5 m	4.1 m



Mon 11 Jul

LW	HW	LW	HW
03:49	10:28	16:28	23:05
1.7 m	4.2 m	1.6 m	4.2 m

Tue 12 Jul

LW	HW	LW
05:05	11:42	17:33
1.6 m	4.3 m	1.5 m

Wed 13 Jul

HW	LW	HW	LW
00:07	06:06	12:43	18:26
4.4 m	1.3 m	4.4 m	1.4 m

Thu 14 Jul

HW	LW	HW	LW
00:58	06:57	13:35	19:12
4.6 m	1.1 m	4.6 m	1.3 m

Fri 15 Jul

HW	LW	HW	LW
01:43	07:43	14:20	19:54
4.7 m	0.9 m	4.6 m	1.3 m

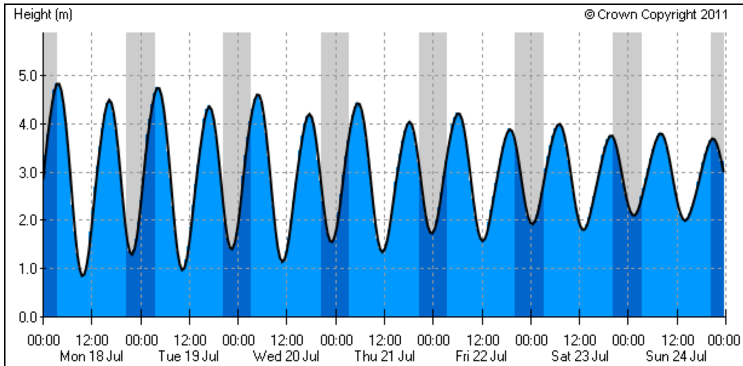
Sat 16 Jul

HW	LW	HW	LW
02:23	08:25	15:02	20:32
4.8 m	0.8 m	4.6 m	1.2 m

Sun 17 Jul

HW	LW	HW	LW
03:02	09:05	15:40	21:09
4.9 m	0.8 m	4.6 m	1.2 m

Figure 2.6 Tidal Predictions for Montrose from 4 to 17 July 2011 (Source: Admiralty Tides, UTC Times)



Mon 18 Jul				Tue 19 Jul				Wed 20 Jul				Thu 21 Jul				Fri 22 Jul			Sat 23 Jul				Sun 24 Jul			
HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW	LW	HW
03:39	09:41	16:18	21:44	04:15	10:16	16:54	22:19	04:51	10:50	17:31	22:54	05:29	11:27	18:09	23:33	06:10	12:07	18:54	00:19	06:59	12:55	19:45	01:19	07:59	13:55	20:47
4.8 m	0.8 m	4.5 m	1.3 m	4.8 m	1.0 m	4.4 m	1.4 m	4.6 m	1.1 m	4.2 m	1.5 m	4.4 m	1.3 m	4.0 m	1.7 m	4.2 m	1.6 m	3.9 m	1.9 m	4.0 m	1.8 m	3.8 m	2.1 m	3.8 m	2.0 m	3.7 m

Figure 2.7 Tidal Predictions for Montrose from 18 July to Survey End (Source: Admiralty Tides, UTC Times)

F3. Overview Survey Results

3.1 *Introduction*

This section presents an overview of the vessel tracks recorded on AIS and radar (non-AIS) during the survey period relative to a 10nm radius from the Forth Round 3 Zone and Phase 1.

The AIS and radar data has been combined. Approximately 94% of all vessels recorded within 10nm of the Forth Round 3 Zone and Phase 1 were fitted with AIS. As the AIS receiver tended to track vessels over a greater range, and also provided more accurate information on position and ship characteristics, the AIS track has been used where the vessel was tracked by both systems. For vessels which had no AIS and were tracked by radar (6%), these have been added to the AIS data to create a single combined data set of all vessels.

The tracks have been colour-coded by vessel type. This information was available from the vast majority of vessels fitted with AIS. Non-AIS radar tracks have been colour-coded based on visual observations, where available.

3.2 *Tracks by Type*

An overview of the combined tracks recorded over the survey period colour-coded by vessel type is presented in Figure 3.1.

It is noted that *Highland Eagle* and other non-routine survey vessels working in and adjacent to Phase 1 (fisheries research vessel *Alba Na Mara*, benthic / bird survey vessel *Clupea*, and survey vessel *Chartwell*) are excluded from the following analysis.

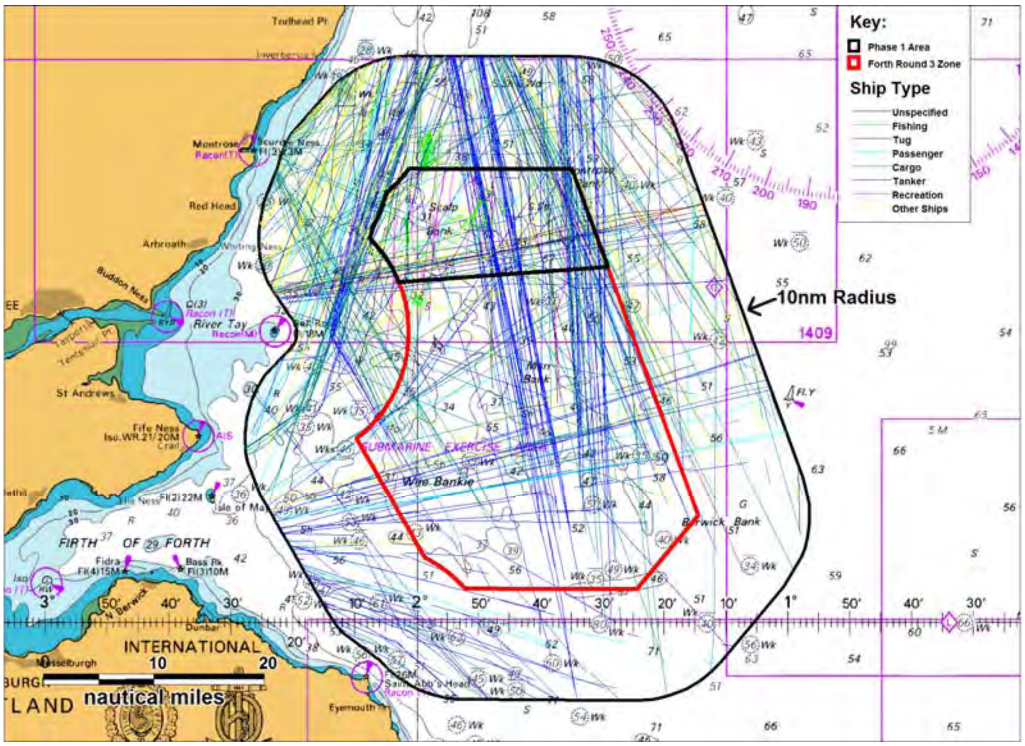


Figure 3.1 Overview of Combined Survey Data by Ship Type (27 Days)

Coverage from the Phase 1 survey extended 10nm from the northern part of the Round 3 Zone, with coverage decreasing (dropping-off) to the south of Zone.

The average number of tracks per day within 10nm of the Forth Zone was based on 27 days of surveying (rounded up from 17 Hours). The busiest day during the survey was Friday 24th June when 45 tracks were recorded, presented in Figure 3.2).

The quietest day was Tuesday 12th July when 7 tracks were recorded (presented in Figure 3.3). The volume of traffic recorded passing the survey location each day was generally consistent over the duration of the survey.

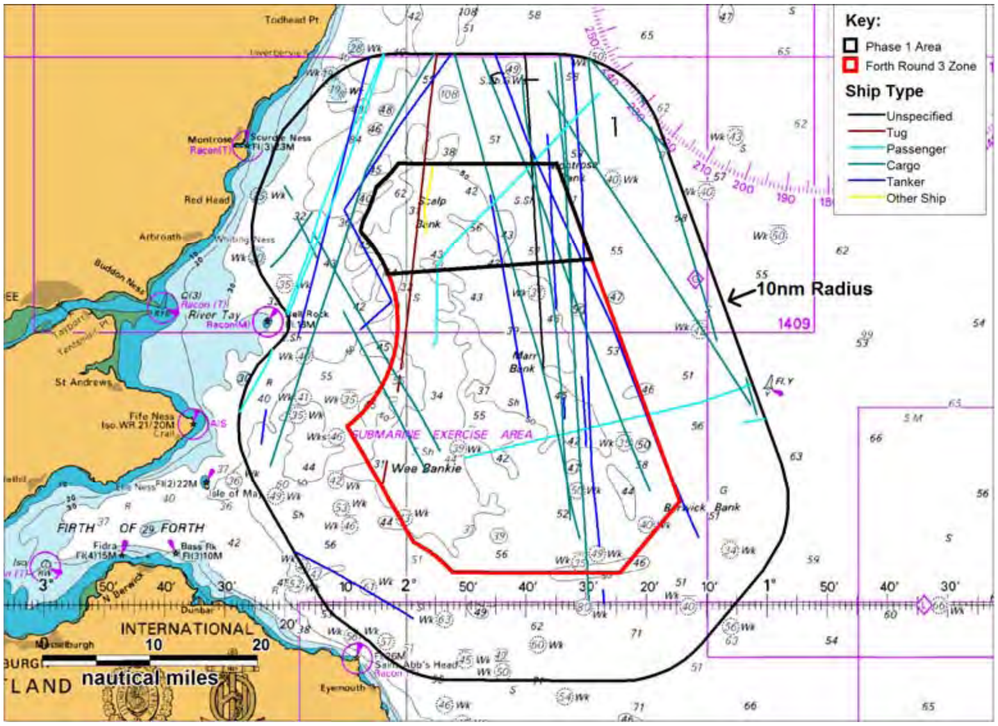


Figure 3.2 Overview of Combined Survey Data on Busiest Day (24 June 2011)

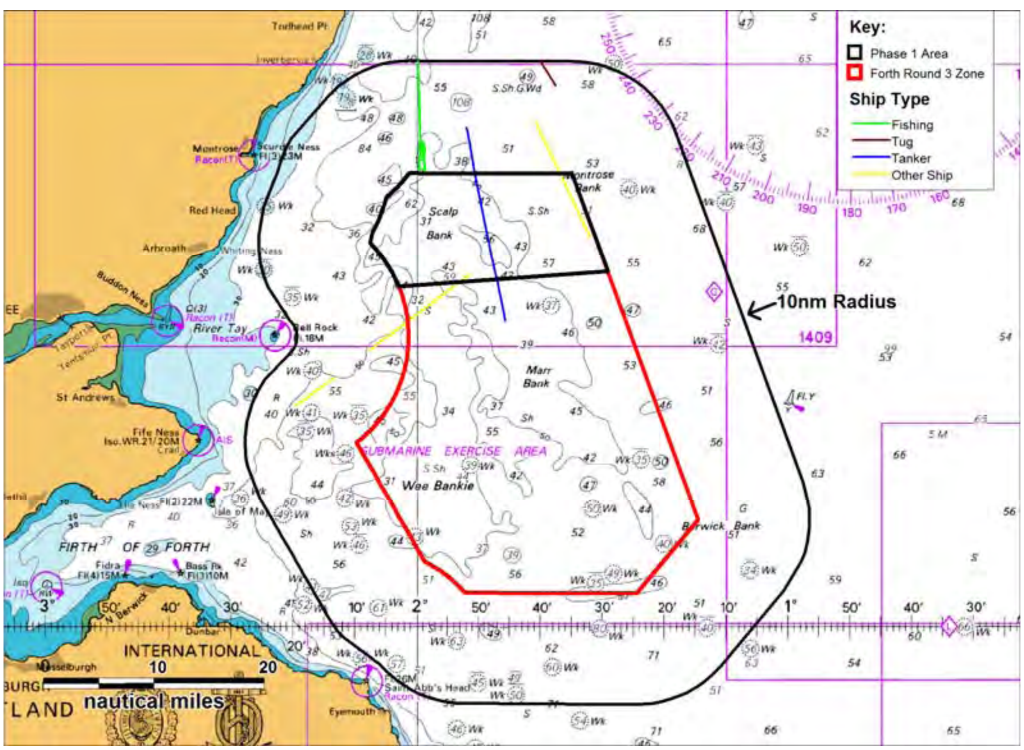


Figure 3.3 Overview of Combined Survey Data on Quietest Day (12 July 2011)

3.3 *Tracks by Size (Draught and Length)*

Based on the information available from AIS and radar observations, the tracks colour-coded by length and draught (where available) are presented in Figure 3.4 and Figure 3.5.

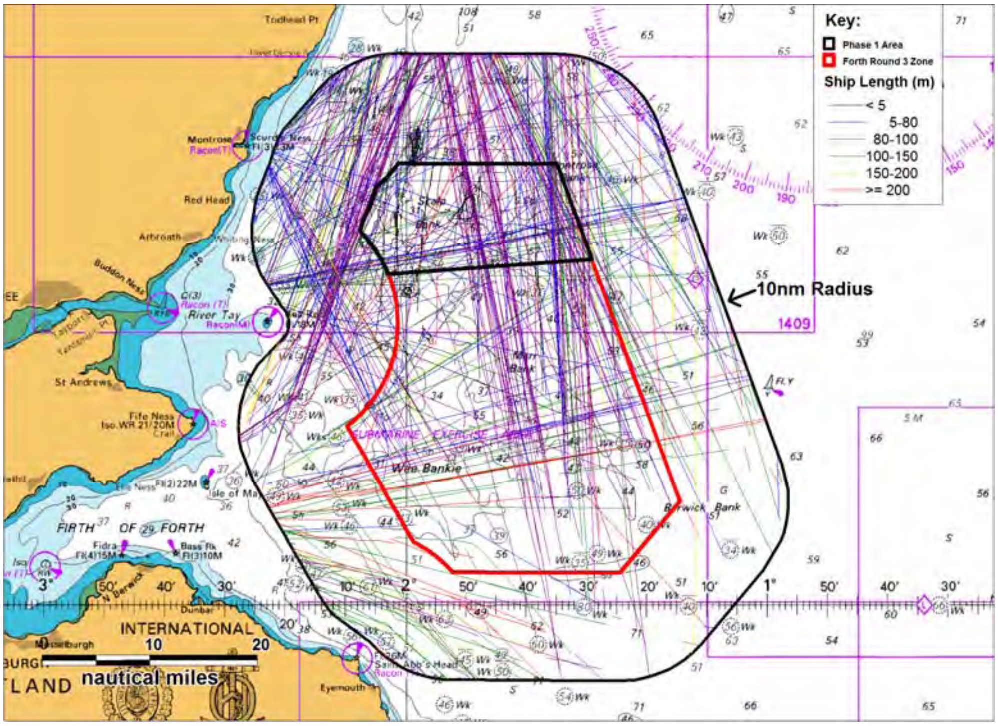


Figure 3.4 Overview of Combined Survey Data by Ship Length (27 Days)

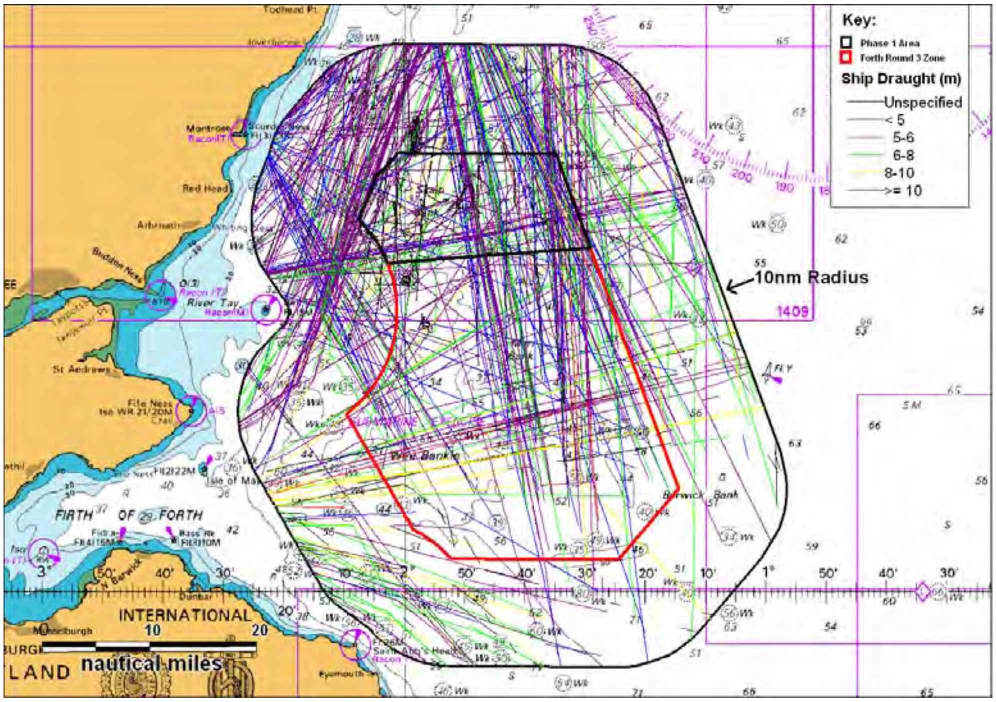


Figure 3.5 Overview of Combined Survey Data by Ship Draught (27 Days)

F4. Detailed Survey Results

4.1 *Introduction*

This section presents a detailed analysis of the vessel tracks recorded on AIS and radar during the survey period relative to the Phase 1 area. The following analysis is presented:

- Ship Type
- Daily Numbers
- Ship Length
- Ship Draught
- Ship Speed
- Average Course
- Destination
- Anchored Ships

4.2 *Shipping Levels and Types*

A plot of the combined data (excluding survey vessel tracks) recorded within 10nm of Phase 1 colour-coded by vessel type is presented in Figure 4.1. It is noted that within 10nm of Phase 1 the survey data composed of 91% AIS and 9% non-AIS vessels.

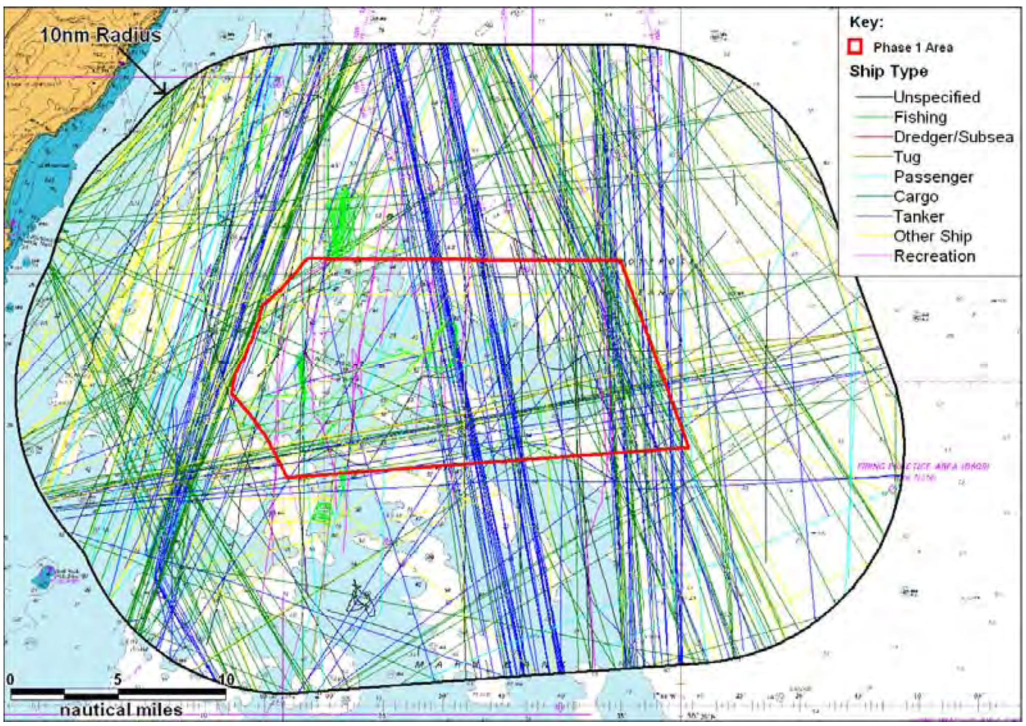


Figure 4.1 Combined Survey Data by Type within 10nm of Phase 1

In total there was an average of 14 vessels per day passing within 10nm of Phase 1 during the 27 day survey in June/July 2011.

Figure 4.2 presents the daily number of vessels passing through Phase 1 during the survey period.

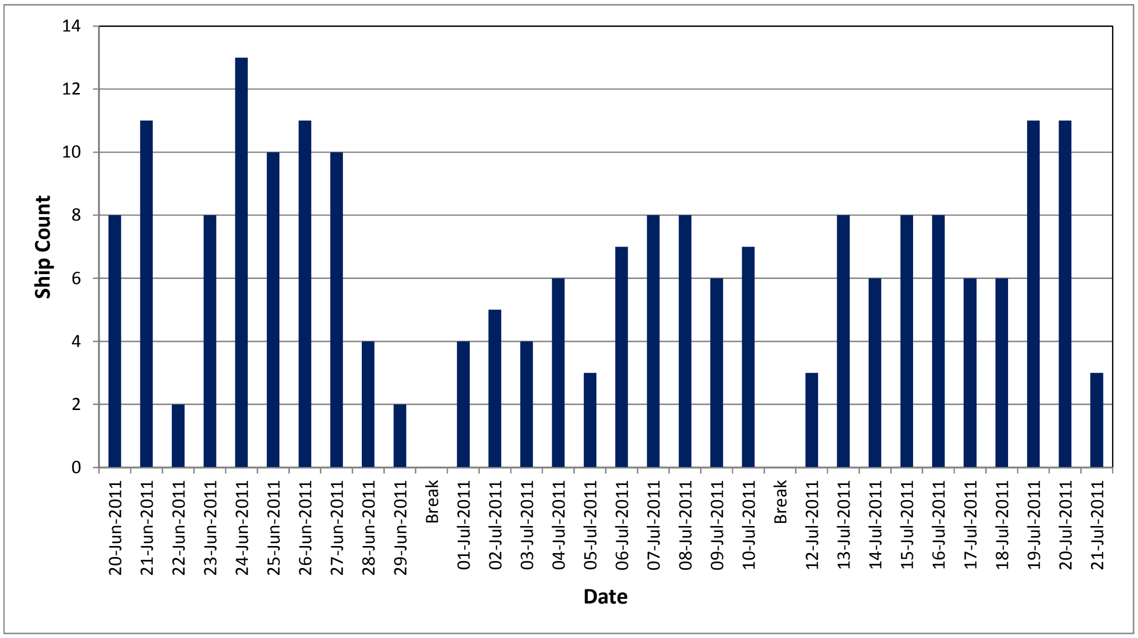


Figure 4.2 Vessels per day Intersecting Phase 1

There was an average of 8 vessels per day passing through Phase 1, with the majority of tracks recorded on AIS vessels (84%) as opposed to non-AIS radar tracks (16%).

The busiest day for vessels passing through the site was Friday 24^{h} June with 13 vessels recorded. The quietest day was Tuesday 5th July with 3 vessels through Phase 1. It is noted that this day was completely recorded as opposed to other partial days in Figure 4.2 with less than 3 unique vessels recorded.

A Plot of the busiest day for vessels passing through Phase 1 is presented in Figure 4.3.

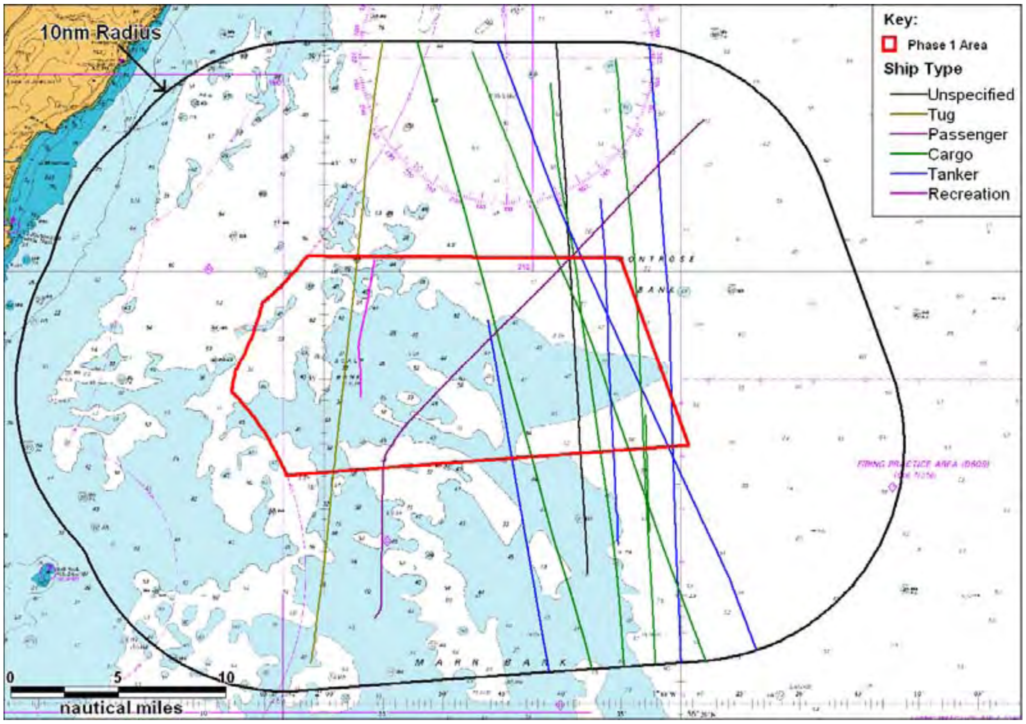


Figure 4.3 Vessels Intersecting Phase 1 - Busiest Day (24 June 2011)

Figure 4.4 presents the type distribution for vessels passing through Phase 1 (excluding 8% unspecified).

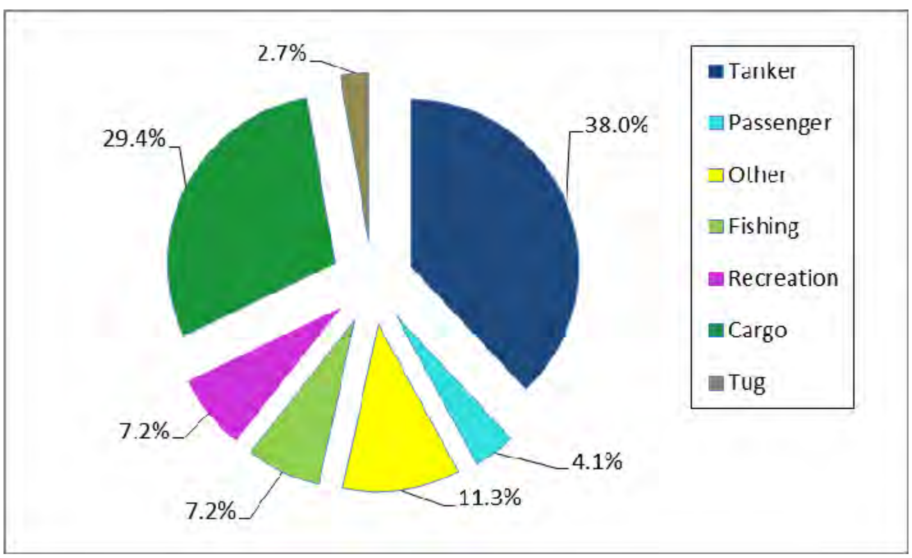


Figure 4.4 Vessel Type Distribution Passing through Phase 1

Tankers and cargo ships were the most common type within Phase 1 comprising 38% and 29% of traffic, respectively. Other ships (mainly offshore vessels) made up 11% of traffic; followed by fishing and recreation vessels contributing just over 7 each%.

4.3 *Ship Length and Draught Information*

Based on the information available from AIS, the tracks colour-coded by length and draught (where available) are presented in Figure 4.5 and Figure 4.7**.**

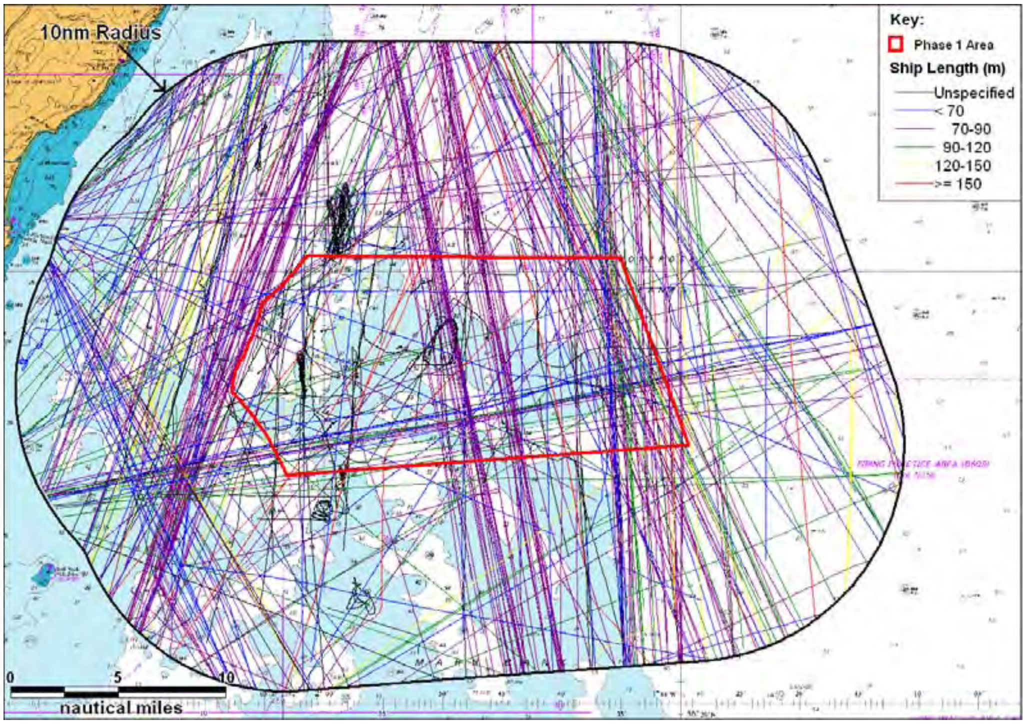


Figure 4.5 Combined Survey Data by Ship Length within 10nm of Phase 1

The average length of vessels passing within Phase 1 during the survey was 73m.

The longest vessel recorded intersecting Phase 1 was the passenger vessel *Crown Princess* at 289m, recorded on one day of the survey headed to Invergordon. This vessel is 50m wide at the beam and broadcast a draught of 8.6m.

The track of *Crown Princess* recorded during the June/July 2011 survey is presented Figure 4.6.

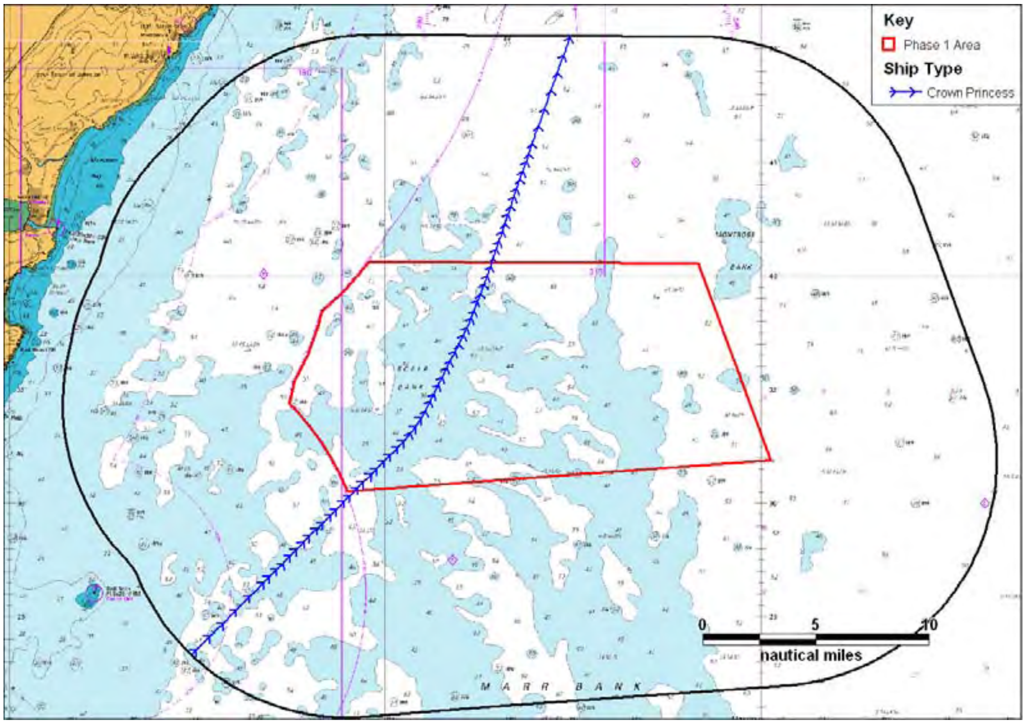


Figure 4.6 AIS Track of the Largest ship Tracked *Crown Princess* (19 July 2011)

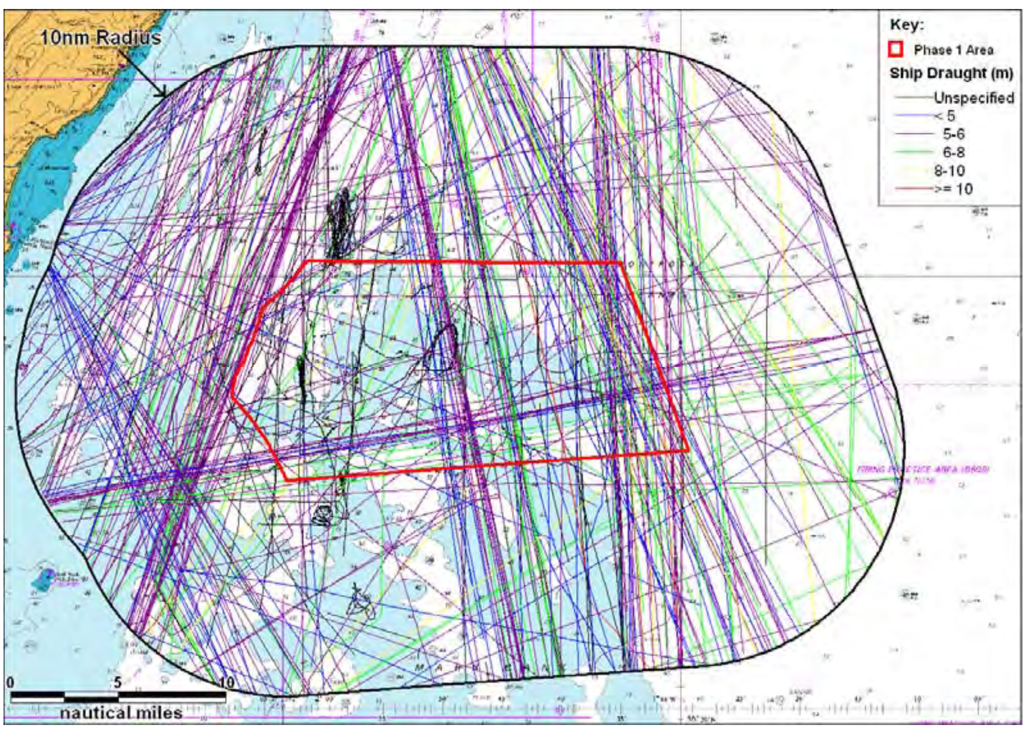


Figure 4.7 Combined Survey Data by Ship Draught within 10nm of Phase 1

The average draught of vessels which passed within Phase 1 during the June 2011 survey was 4m.

The deepest draught vessel was *Hanne Knutsen* recorded on two days of the survey headed to Teesport. This is a 123,581 DWT Tanker vessel, with draught broadcast at 16m.

The tracks of *Hanne Knutsen* recorded during June/July 2011 are presented in Figure 4.8.

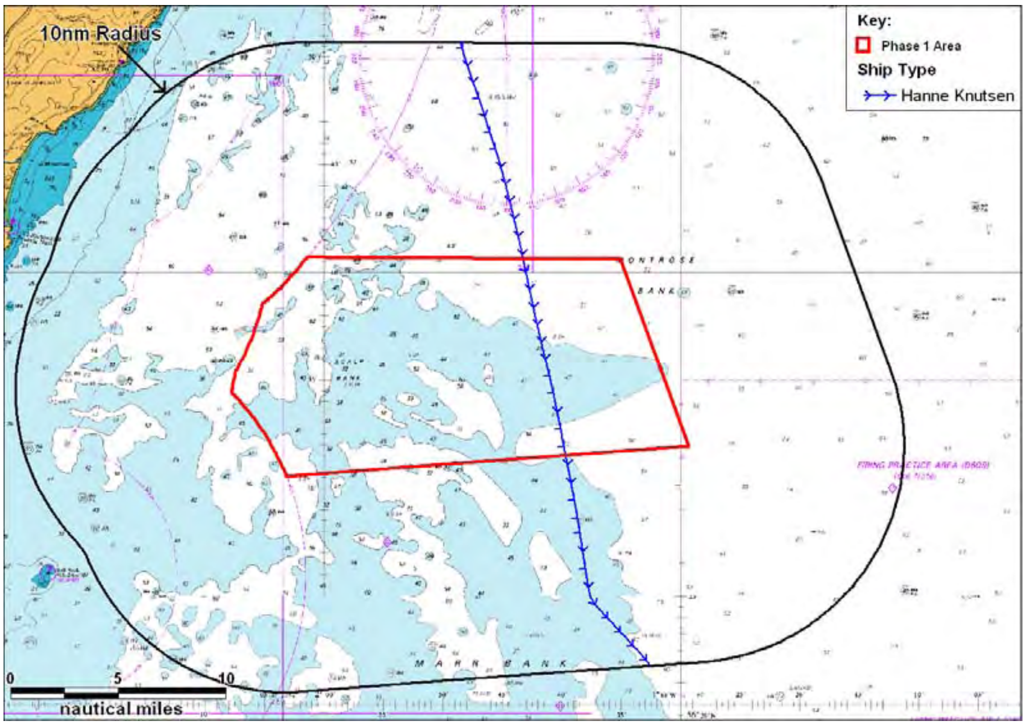


Figure 4.8 AIS Track of the Deepest Draught ship Tracked *Hanne Knutsen* (18/19 July 2011)

4.4 *Speed Distribution*

The speed distribution of the vessels tracked within Phase 1 is summarised in Figure 4.9.

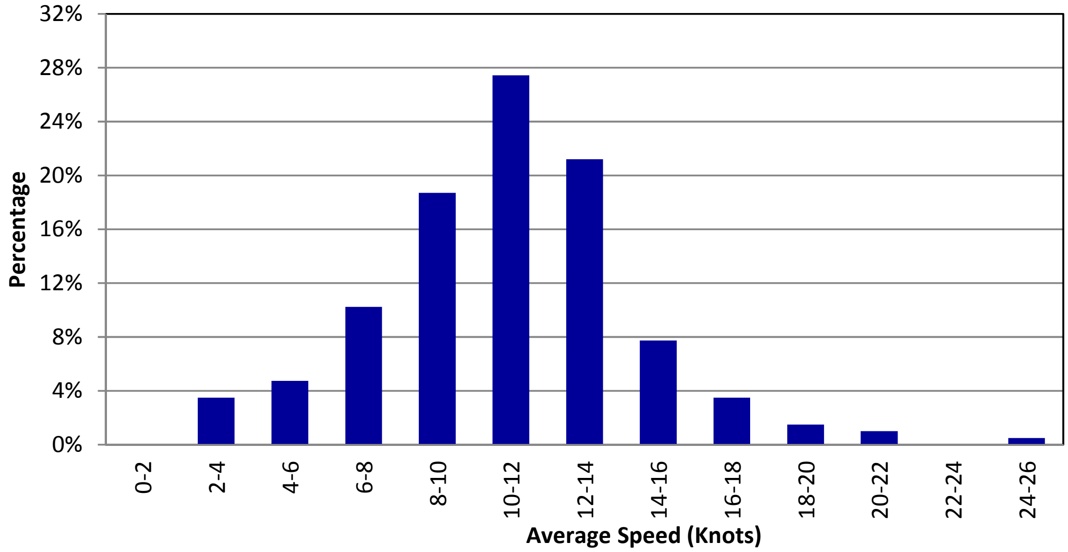


Figure 4.9 Speed Distribution of Vessels Passing within Phase 1

The average speed was 10.8 knots. The fastest vessel tracked within Phase 1 was a non-AIS recreation vessel travelling at 25 knots. The fastest AIS target was *Crown Princess* Cruise vessel travelling at an average speed of 22 knots headed northbound to Invergordon.

4.5 *Average Course*

The tracks colour coded by average course, are presented in Figure 4.10.

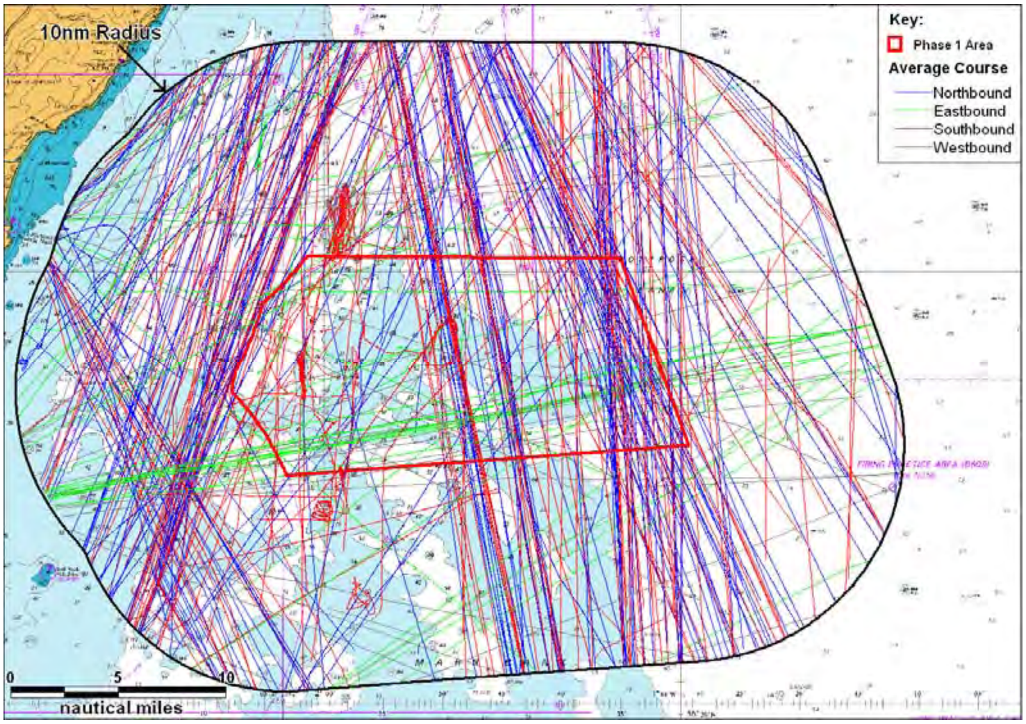


Figure 4.10 Combined Survey Data by Average Course within 10nm of Phase 1

The average course of the traffic within 10nm of Phase 1 was northbound (41%), southbound (39%), eastbound (10%) and westbound (10%). It is noted that the average of course of fishing vessels (steaming and fishing) were included in Figure 4.10.

4.6 *Destinations*

The destinations of vessels tracked within Phase 1 are summarised in Figure 4.11.

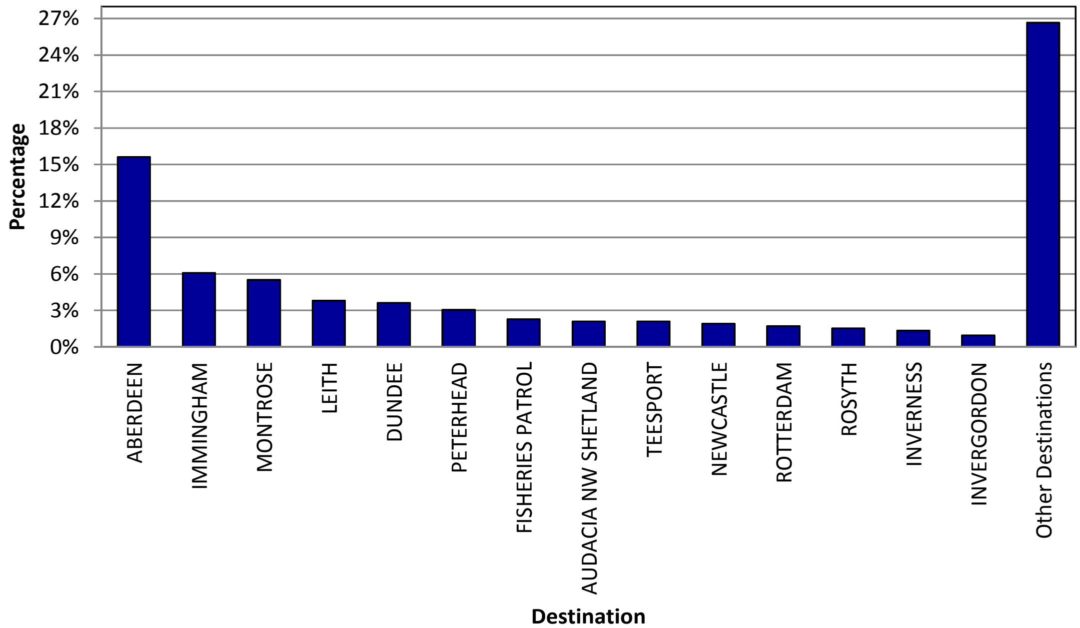


Figure 4.11 Main Destination Ports of Vessels Passing through Phase 1

It can be seen that the main regular destinations were Aberdeen (16%) and Immingham (6%). Other common destinations included North Eastern Scottish and English ports (Montrose, Leith, Peterhead and Dundee).

Just under one quarter of vessels tracked (27%) were recorded headed to various other destinations in the UK (Buckie, Northern Isle and Belfast) Scandinavian and mainland Europe.

4.7 *Anchored Vessels*

Anchored vessels are identified based on AIS navigational status which is set on the AIS unit on-board a vessel. Information is manually inputted into the AIS transponder; therefore it is common for ships not to update the navigational status if they are anchored for only a short period of time. Subsequently, the data was analysed for vessels with low speeds or ship tracks which showed signs of anchoring.

No vessels were identified as been at anchor within 10nm of Phase 1 during the summer survey.

F5. Review of Survey Data by Vessel Type

This section presents more detailed analysis of the survey data by vessel type.

5.1 *Cargo Vessels*

The cargo vessels tracked within 10nm of Phase 1 are shown in Figure 5.1.

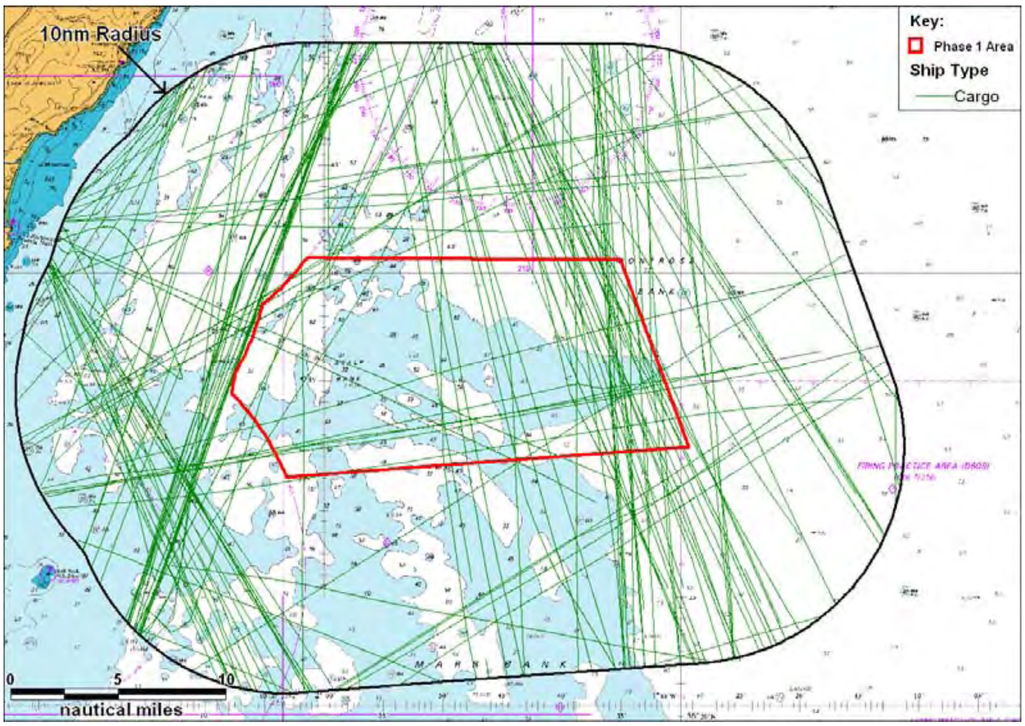


Figure 5.1 Cargo Vessels Recorded within 10nm of Phase 1

Cargo ships were the most common type within 10nm of Phase 1, with the majority headed north/south bound. An average of 2 cargo vessels per day passed through Phase 1 during the survey.

5.2 *Tankers*

Figure 5.2 presents a chart overview of the tankers recorded intersecting Phase 1 during the survey.

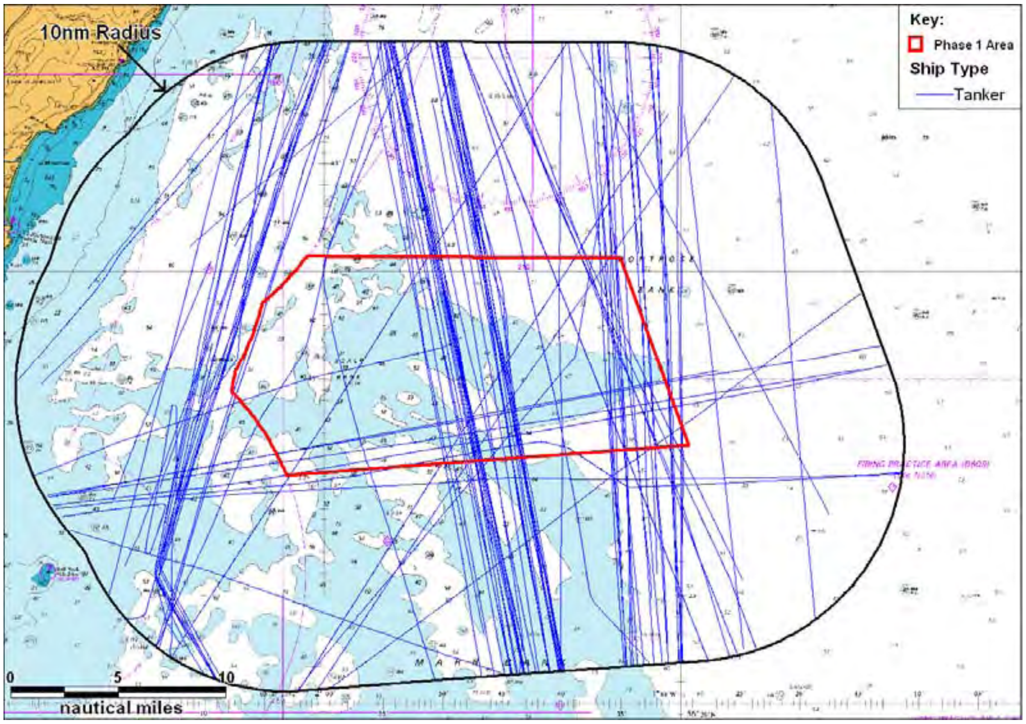


Figure 5.2 Tankers Recorded within 10nm of Phase 1

Tankers were the second most common vessel type within 10nm of Phase 1, taking similar routes to cargo vessels. However there were a higher number of tankers intersecting Phase 1 compared to cargo vessels with approximately 3 tankers per day.

5.3 *Fishing Vessels*

Figure 5.3 presents a chart overview of the fishing vessels recorded intersecting Phase 1 during the survey.

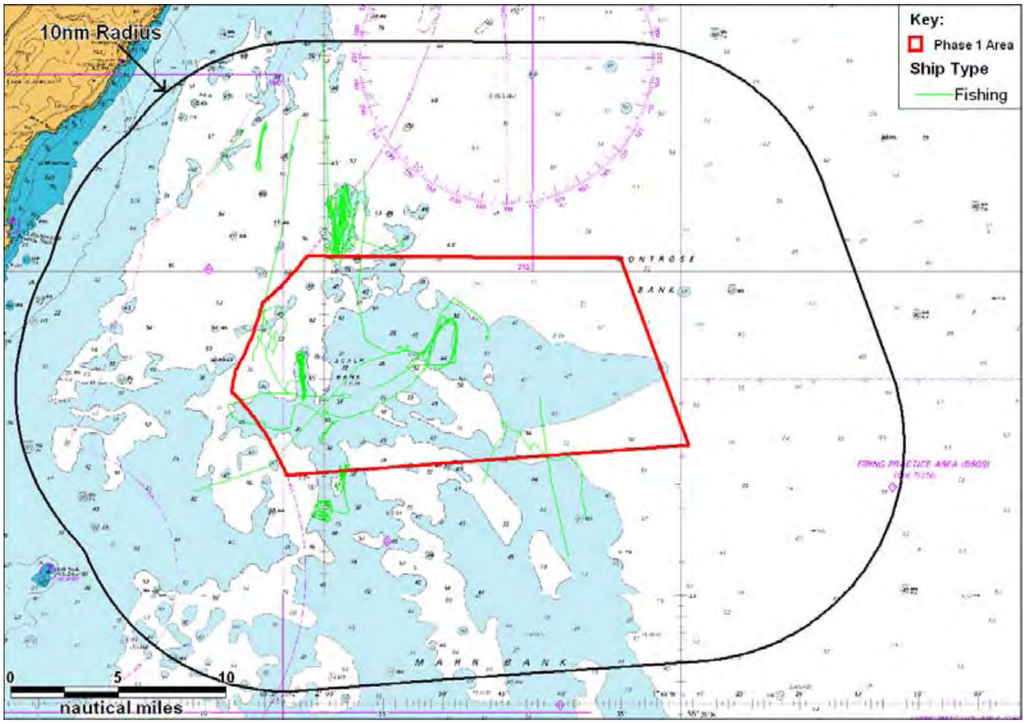


Figure 5.3 Fishing Vessels Recorded within 10nm of Phase 1

An average of less than 1 fishing vessel per day was recorded within Phase 1 during the survey. The fishing vessel tracked most frequently was the scallop dredger *Natalie B H1074* recorded on three days of the survey operating within Phase 1 and 1.4nm north of the area 1.

A photograph of the *Natalie B H1074* scallop dredger taken during the summer survey is presented in Figure 5.4 (over-leaf).

Figure 5.4 Photograph of *Natalie B H1074* Taken during the survey (13th July 2011)

5.4 *Other Vessels*

Figure 5.5 presents a chart overview of the other ships category recorded during the survey.

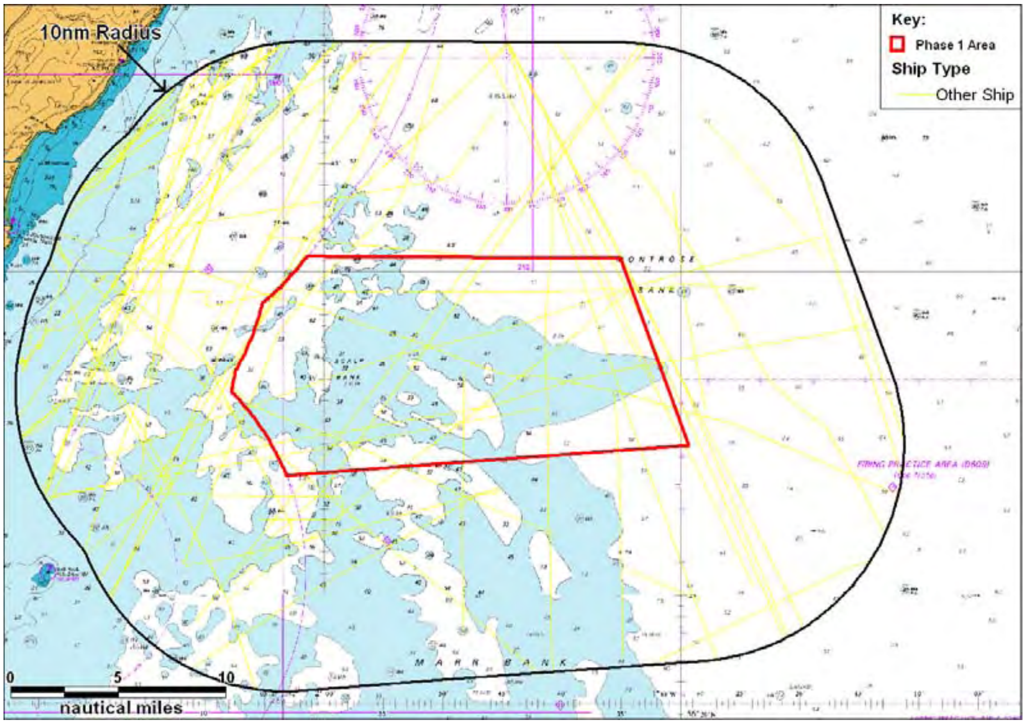


Figure 5.5 Other Ships Recorded within 10nm of Phase 1

There was an average of less than 1 other vessel per day within Phase 1 during the survey. A large majority of other ships were offshore supply/support vessels headed between Aberdeen, Dundee and Leith to North Sea oil and gas platforms.

5.5 *Recreation Vessels*

Figure 5.5 presents a chart overview of the other ships category recorded during the survey.

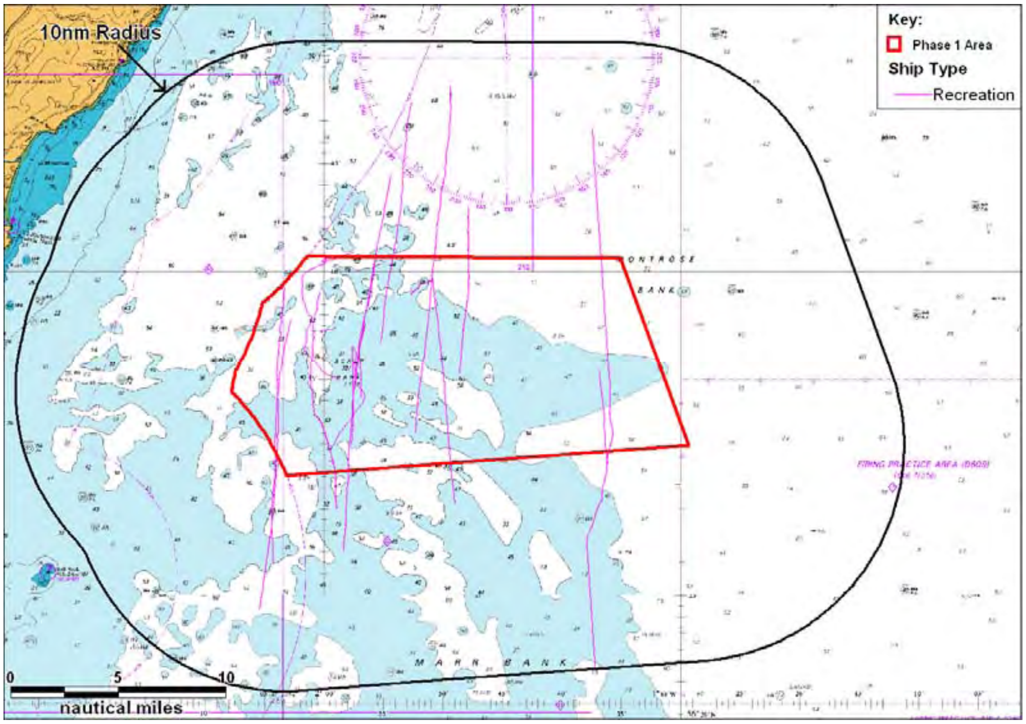


Figure 5.6 Recreational Vessels Recorded within 10nm of Phase 1

An average of just under 1 recreational vessel per day was recorded within Phase 1 during the survey, with sailing vessels likely to be taking cruising routes from north east Scotland to marinas in northern England.

Four sailing yachts were recorded on Tuesday 28th June and there were 2 recreational vessels recorded on Monday 27th June, Sunday 3rd July and Friday 8th July respectively..

5.6 *Hazardous Cargo Type*

In AIS data the hazardous cargo type is based on four classifications (A to D) with hazardous cargo type A being defined as the most harmful. Vessels voluntarily record the harmfulness to the marine environment of the cargo carried, defined by the following dangerous goods types:

- Carrying Dangerous Goods (DG);
- Harmful Substances (HS);
- Marine Pollutants (MP).

The hazardous cargo type as defined by International Maritime Dangerous Goods (IMDG) Code broadcast on AIS (where available) is presented in Figure 5.7.

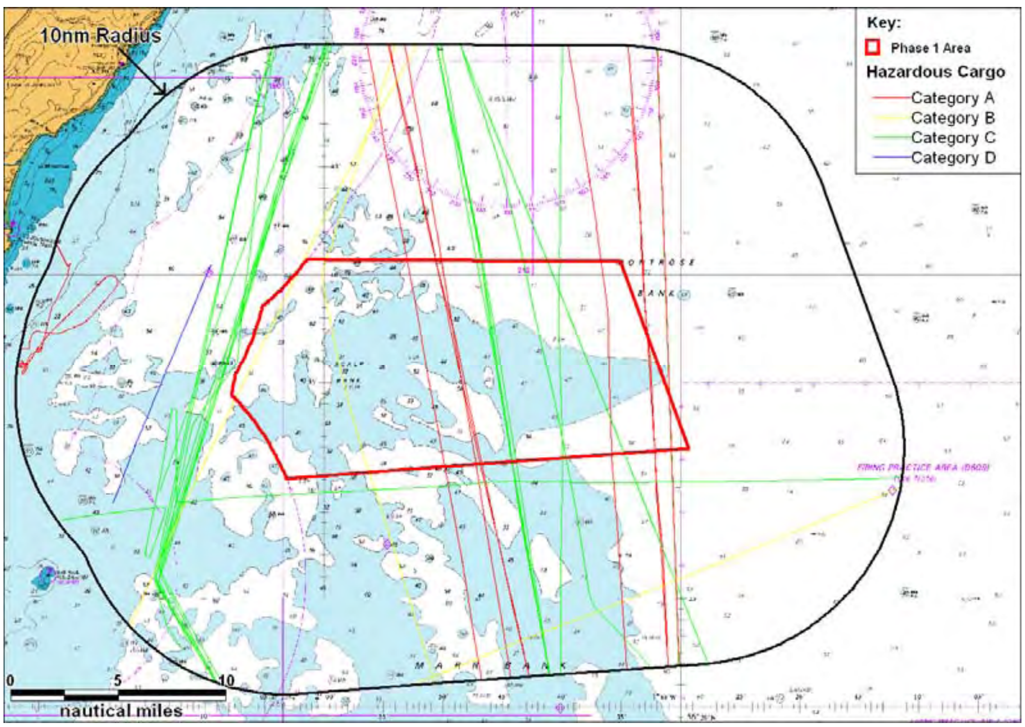


Figure 5.7 Hazardous Cargo Vessels Recorded within 10nm of Phase 1

During the survey an average of less than 1 vessel every two days was recorded with hazardous cargo within Phase 1. The majority of vessels carrying hazardous cargo were Products Tankers headed between Aberdeen and Immingham.

The most active vessels with hazardous cargo intersecting Phase 1 were *Aspirity*, *Audacity*, *Hanne Knutsen* and *Thames* – generally headed between Aberdeen/Peterhead and Tees, Humber and Rotterdam.

F6. Phase-Specific Analysis

6.1 *CPA Analysis*

A detailed analysis of shipping passing within 5nm of Phase 1 was carried out to assess the distribution of closest passing distances during the survey. The minimum passing distance of ships passing within 5nm of Phase 1 is presented in Figure 6.1.

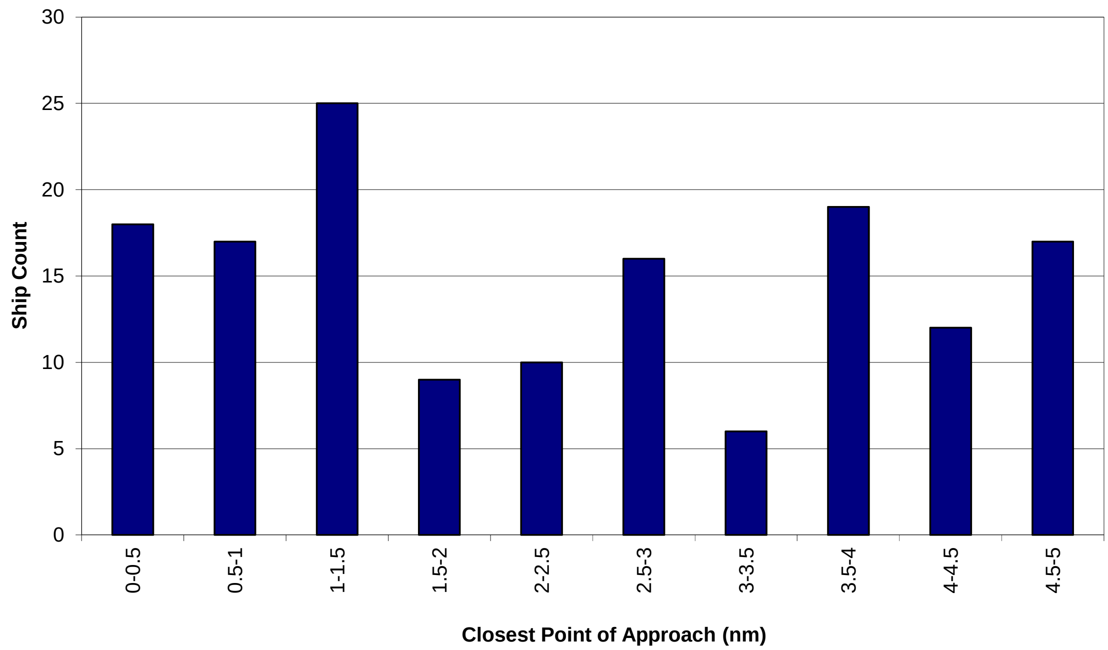


Figure 6.1 CPA Distribution of Tracks passing within 5nm of Phase 1

Eighteen vessels were recorded passing within 0.5nm and seventeen vessels passed between 0.5-1nm of Phase 1 during the survey period.

6.2 *Summary of Intersecting Vessels*

A summary of the vessels that crossed Phase 1 on more than one occasion and the number of times they crossed the area are presented in Table 6.1. Note that when a vessel left the zone and then re-entered very soon after, these have been counted as a single crossing.

Table 6.1 Vessels Intersecting Phase 1 (at least one crossing)

Ship Name	Type	Ship Manager	Crossings
Clipper Burgundy	Chemical/Products Tanker	Nordic Tankers Marine A/S	15
Solway Fisher	Products Tanker	James Fisher Shipping Services	11
Vedrey Hallarna	Chemical/Products Tanker	V Ships UK Ltd	10
Audacity	Products Tanker	James Fisher Shipping Services	6
Milford Fisher	Products Tanker	James Fisher Shipping Services	5
Birch	General Cargo Ship	VW Nyki Shipping	4
Shannon Fisher	Products Tanker	James Fisher Shipping Services	4
Asperity	Products Tanker	James Fisher Shipping Services	3
Frifjord	General Cargo Ship	Kopervik Ship Management AS	3
Speciality	Products Tanker	James Fisher Shipping Services	3
Sarnia Liberty	Chemical/Products Tanker	James Fisher Shipping Services	3
Thames Fisher	Products Tanker	James Fisher Shipping Services	3
Anne Scott	Fishing Vessel	n/a	2
Victress	General Cargo Ship	Faversham Ships Ltd	2
Courage	Fishing Vessel	Normac Fraserburgh Ltd	2
KL Sandefjord	Anchor Handler/Offshore Supply	OSM Ship Management AS	2
Merle	General Cargo Ship	Nyki Shipping BV	2
Swedica Hav	General Cargo Ship	Hav Ship Management	2
UAL Ghana	General Cargo Ship	Carisbrooke Shipping Mgmt. GmbH	2
NSO Spirit	Offshore Supply	Troms Offshore Management AS	2
Brin-Navolok	General Cargo Ship	Belfreight JSC	2
Holmfoss	Refrigerated Cargo Ship	Eimskip Ehf	2
Prisendam	Cruise Vessel	Holland America Line Inc.	2

Ship Name	Type	Ship Manager	Crossings
Boa Brage	Tug	Taubatkompaniet AS	2
Ocean Sprite	Emergency Rescue Response Vessel	Sartor Offshore Rescue Ltd	2
Sea Mithril	General Cargo Ship	Torbulk Ltd	2
Alcedo	Asphalt/Bitumen Tanker	Nynas AB	2
UAL Ghana	General Cargo Ship	Carisbrooke Shipping Mgmt GmbH	2
Arklow Mill	General Cargo Ship	Arklow Shipping Ltd	
Vedette	General Cargo Ship	Faversham Ships Ltd	
Amur-2526	General Cargo Ship	Northern River Shipping	

The Chemical/Products tanker *Clipper Burgundy* was the most frequently recorded vessel passing through Phase 1 with 15 crossings during the survey period. It was mainly travelling between Aberdeen and Immingham with occasional callings at Peterhead and Scapa Flow.

It is noted that the ship operator has been consulted as part of the Firth and Tay Offshore Wind Developers Group (FTOWDG) regional work.

F7. Conclusions

This report has provided an analysis of the summer AIS and radar shipping tracks recorded for the second period of surveying in Phase 1 within the Firth of Forth Zone.

Overall, the survey achieved the aims to gather data on a range of vessel types over 26 days during summer 2011. This second survey validated and provided a seasonal overview of vessel activity within Phase 1 which is in line with MCA guidance (MGN 371) (Ref. ii).

F8. References

i Anatec Ltd, Maritime Traffic Survey Report (March 2011), Seagreen, Anatec Ltd, Report No: A2520- SG -TS-1, 17 May 2011.

ii MCA Marine Guidance Note MGN 371 on the Navigational Safety Issues associated with Offshore Renewable Energy Installations (OREI).

Consequences Assessment

Phase 1

(Appendix G)

Prepared by:	Anatec Limited
Presented to:	Seagreen
Date:	5th July 2012
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TABLE OF CONTENTS

G1. Introduction

This Appendix presents an assessment of the consequences of collision incidents, in terms of people and the environment, due to the impact of the proposed Phase 1 wind farms (Project Alpha and Project Bravo) in the Firth of Forth Round 3 zone.

The significance of the impact of Project Alpha and Project Bravo is also assessed based on risk evaluation criteria and comparison with historical accident data in the UK waters[1].

G2. Risk Evaluation Criteria

2.1 Risk to People

With regard to the assessment of risk to people two measures are considered, namely;

- Individual Risk
- Societal Risk

2.1.1 Individual Risk (per Year)

This measure considers whether the risk from an accident to a particular individual changes significantly due to the wind farm. Individual risk considers not only the frequency of the accident and the consequence (likelihood of death), but also the individual's fractional exposure to that risk, i.e., the probability of the individual of being in the given location at the time of the accident.

The purpose of estimating the Individual Risk is to ensure that individuals, who may be affected by the presence of the wind farm, are not exposed to excessive risks. This is achieved by considering the significance of the change in individual risk resulting from the presence of the wind farm, relative to the background individual risk levels.

Annual individual risk levels to crew (i.e., the annual fatality risk of an average crew member) for different ship types are presented in Figure 2.1 (Ref.i). The figure also highlights the risk acceptance criteria as suggested in International Maritime Organisation (IMO) Marine Safety Committee (MSC) 72/16.

[1] In this technical note, UK waters means the UK Exclusive Economic Zone and UK territorial waters means within the 12 nautical miles limit.

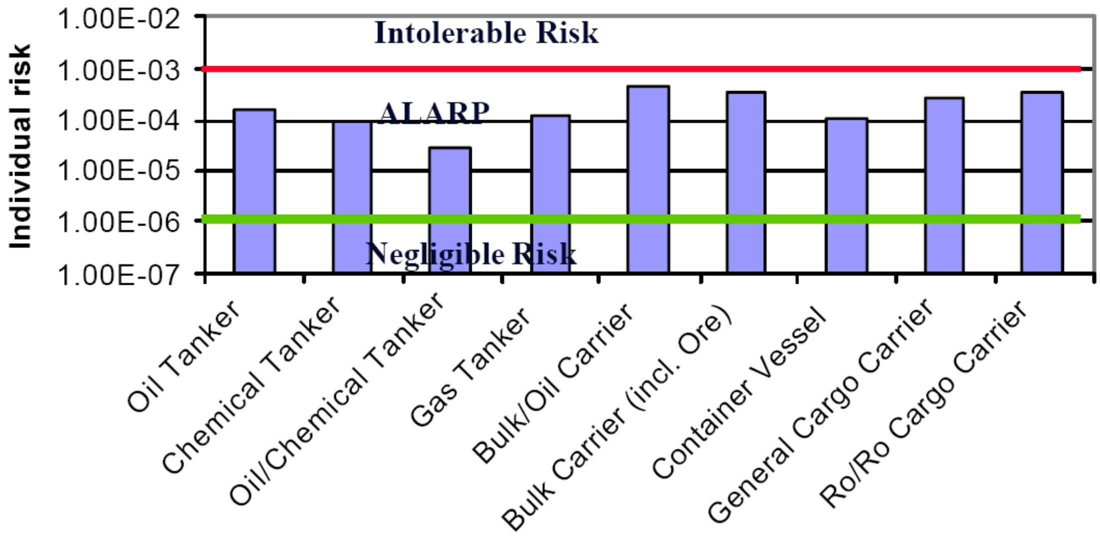

Figure 2.1 Individual Risk Levels and Acceptance Criteria per Ship Type

Typical bounds defining the As Low As Reasonably Practicable (ALARP) regions for decision making within shipping are as follows.

Table 2.1 Individual Risk ALARP Criteria

Individual	Lower Bound for ALARP	Upper Bound for ALARP
To crew member	10^{-6}	10^{-3}
To passenger	10^{-6}	10^{-4}
3rd party	10^{-6}	10^{-4}
New ship target	10^{-6}	Above values reduced by one order of magnitude

On a UK basis, the Marine Coastguard Agency (MCA) website presents individual risks for various UK industries based on Health and Safety Executive (HSE) data for 1987-91 (Ref. ii). The risks for different industries are compared in Figure 2.2.

The individual risk for sea transport of 2.9 x 10^{-4} per year is consistent with the worldwide data presented in Figure 2.1, whilst the individual risk for sea fishing of 1.2 x 10^{-3} per year is the highest across all of the industries listed.

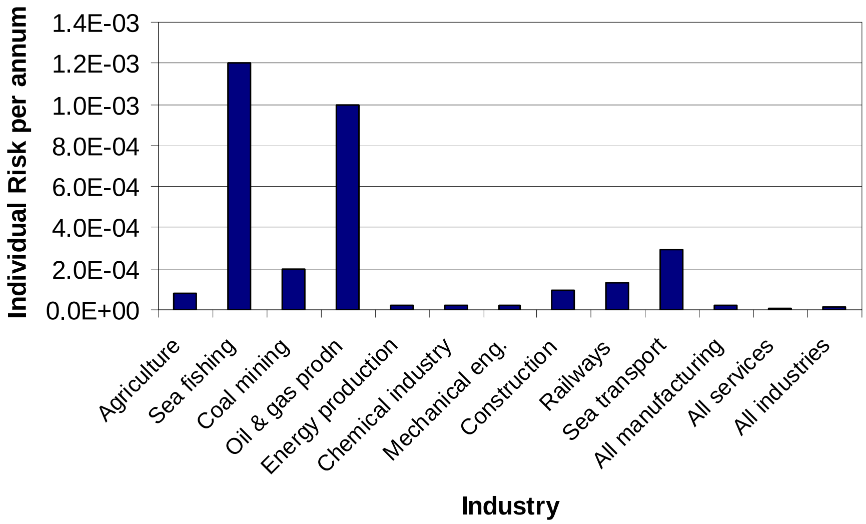

Figure 2.2 Individual Risk per Year for various UK Industries

2.1.2 Societal Risk

Societal Risk is used to estimate risks of accidents affecting many persons, e.g., catastrophes, and acknowledging risk averse or neutral attitudes. Societal Risk includes the risk to every person, even if a person is only exposed on one brief occasion to that risk. For assessing the risk to a large number of affected people, societal risk is desirable because individual risk is insufficient in evaluating risks imposed on large numbers of people.

Within this assessment societal risk (navigational based) can be assessed for the proposed Phase 1 wind farms giving account to the change in risk associated with each accident scenario caused by the introduction of the structures. Societal risk may be expressed as:

- Annual fatality rate: frequency and fatality are combined into a convenient one-dimensional measure of Societal Risk. This is also known as Potential Loss of Life (PLL).

- FN-diagrams showing explicitly the relationship between the cumulative frequency of an accident and the number of fatalities in a multi-dimensional diagram.

When assessing societal risk this study focuses on PLL, which takes into account the number of people likely to be involved in an incident (which is higher for passenger ferries, for example), and assesses the significance of the change in risk compared to background risk levels for the UK.

2.2 Risk to Environment

For risk to the environment, the key criteria considered in terms of the effect of Project Alpha and Project Bravo is the potential amount of oil spilled from the vessel involved in an incident.

It is recognised there will be other potential pollution, e.g., hazardous containerised cargoes, however, oil is considered the most likely pollutant and the extent of predicted oil spills will provide an indication of the significance of pollution risk due to the proposed Phase 1 wind farms compared to background pollution risk levels for the UK.

G3. MAIB Incident Analysis

3.1 All Incidents

All UK commercial vessels are required to report accidents to Marine Accident Investigation Branch (MAIB). Non-UK vessels do not have to report unless they are in a UK port or are in 12 nautical mile territorial waters and carrying passengers to a UK port. There are no requirements for non-commercial recreational craft to report accidents to MAIB, however, a significant proportion of these incidents are reported and investigated by the MAIB.

A total of 19,130 accidents, injuries and hazardous incidents were reported to MAIB between 1 January 1994 and 27 September 2005 involving 21,140 vessels (some incidents such as collisions involved more than one vessel). 72% of incidents were in UK waters with 28% reported in foreign waters.

The locations[1] of incidents reported in the vicinity of the UK are presented in Figure 3.1, colour-coded by type.

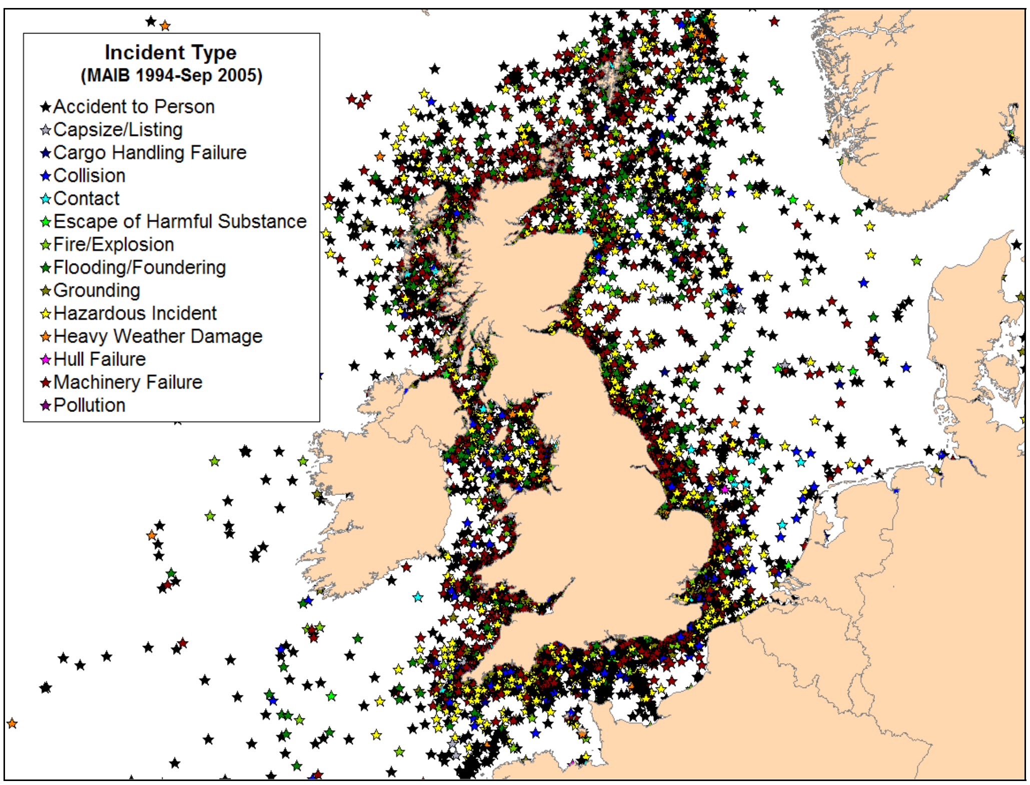

Figure 3.1 Incident Locations by Type (MAIB 1994-Sep 2005)

[1] MAIB aim for 97% accuracy in reporting the locations of incidents.

The distribution of incidents by year is presented in Figure 3.2.

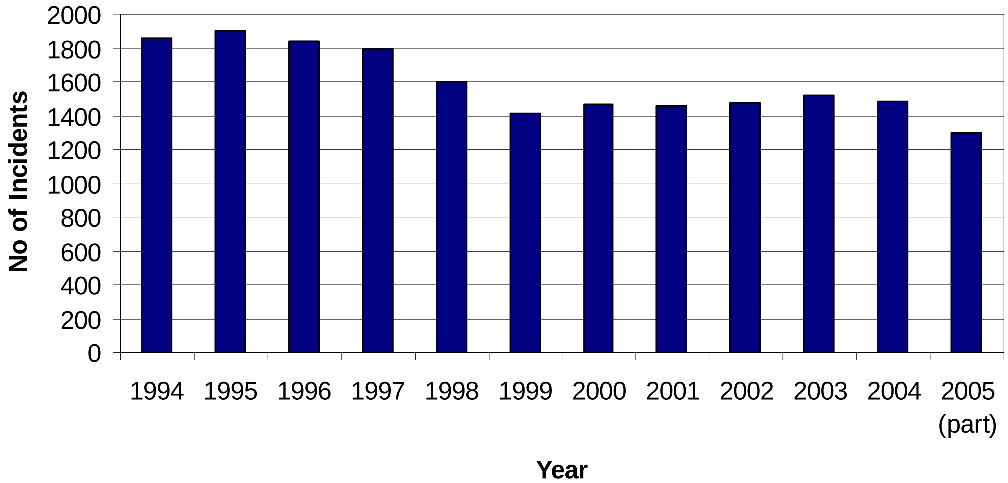

Figure 3.2 Incidents per Year (MAIB 1994-Sep 2005)

The average number of incidents per year, excluding 2005 which is a part-year, was 1,621. There is a declining trend in incidents.

The distribution by incident type is presented in Figure 3.3.

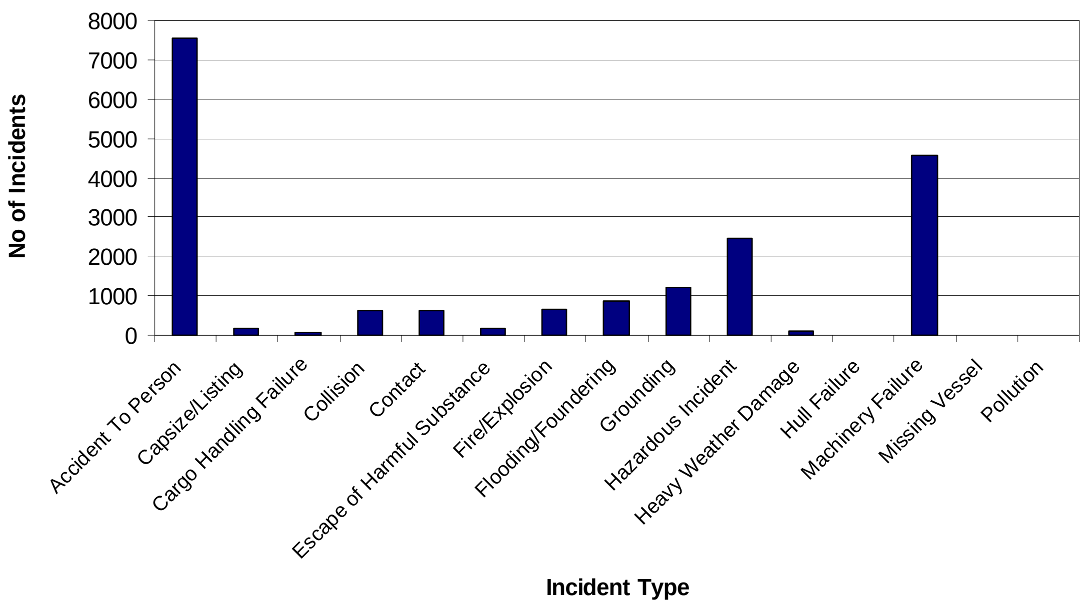

Figure 3.3 Incidents by Incident Type (MAIB 1994-Sep 2005)

Therefore, the most common incident types were Accident to Person[1] (40%), Machinery Failure (24%) and Hazardous Incident (13%). Collisions and Contacts each represented 3% of total incidents.

The distribution of vessel type categories involved in incidents is presented in Figure 3.4.

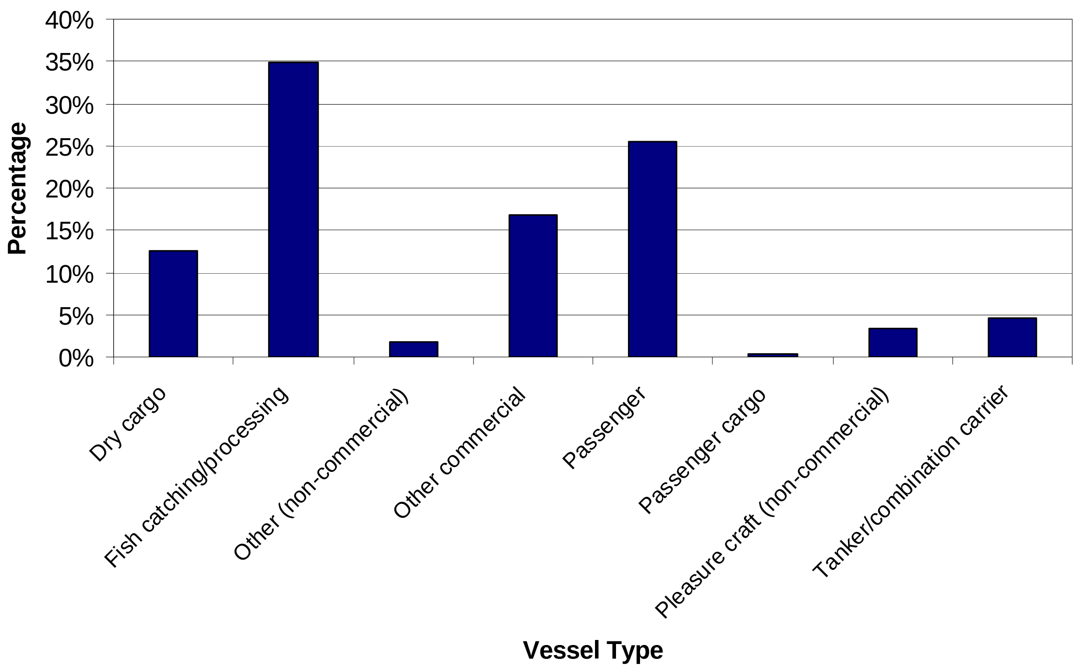

Figure 3.4 Incidents by Vessel Type (MAIB 1994-Sep 2005)

The most common vessel types involved in incidents were fishing vessels (35%), passenger vessels (25%) and other commercial vessels (17%), which includes offshore industry vessels, tugs, workboats and pilot vessels.

The total number of fatalities per year (divided into crew, passenger and other) reported in the MAIB incidents is presented in Figure 3.5.

[1] Where the incident is an accident to a vessel, e.g., collision or machinery failure, it would be reported under this vessel accident category.

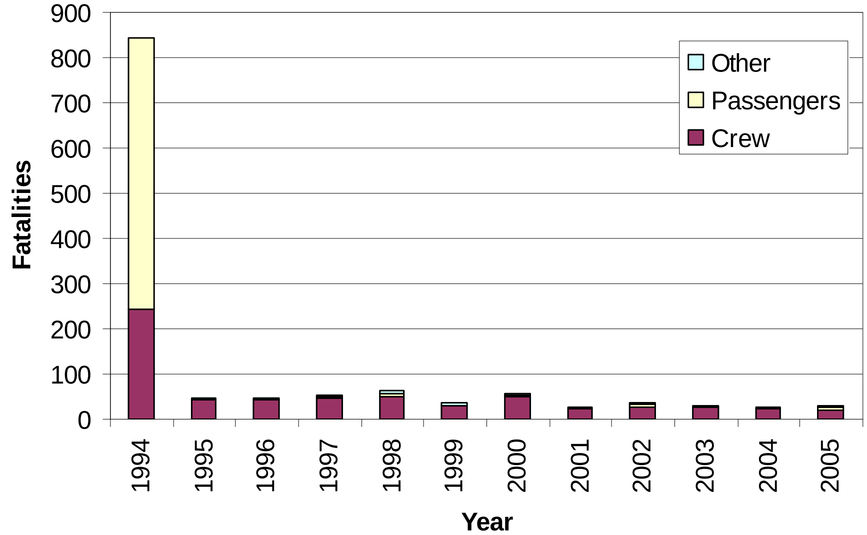

Figure 3.5 Number of Fatalities (MAIB 1994-Sep 2005)

The average number of fatalities per year, excluding 2005 which is a part-year, was 115. The sinking of the 'Estonia' passenger ferry in the Baltic Sea in 1994, which resulted in a reported 852 fatalities, dominates the figures. If 1994 were excluded, the average number of fatalities per year would drop to 42.

Considering only the incidents reported to have occurred in UK territorial waters, the number of fatalities per year is presented in Figure 3.6.

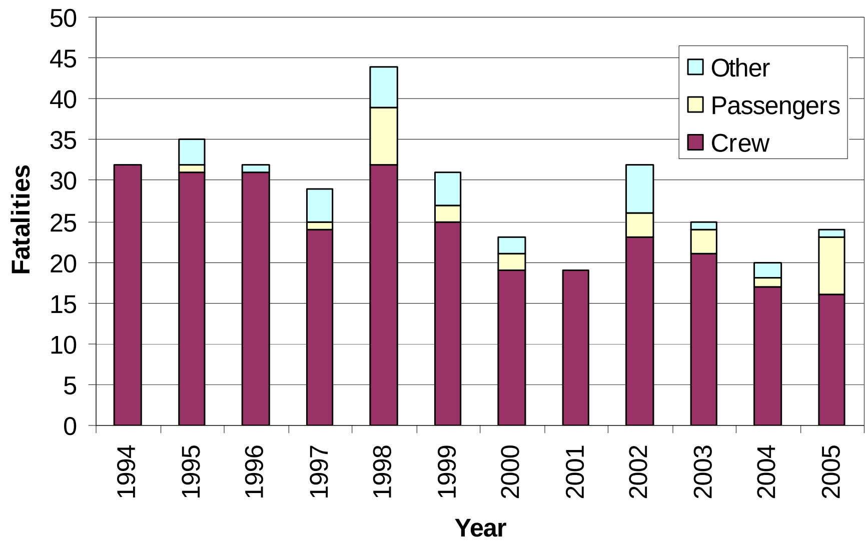

Figure 3.6 Number of Fatalities for Incidents in UK Waters (MAIB 1994-Sep 2005)

Therefore, the average number of fatalities per year in UK territorial waters between 1994 and 2004 was 29.

The distribution of fatalities in UK waters by vessel type and person category is presented in Figure 3.7.

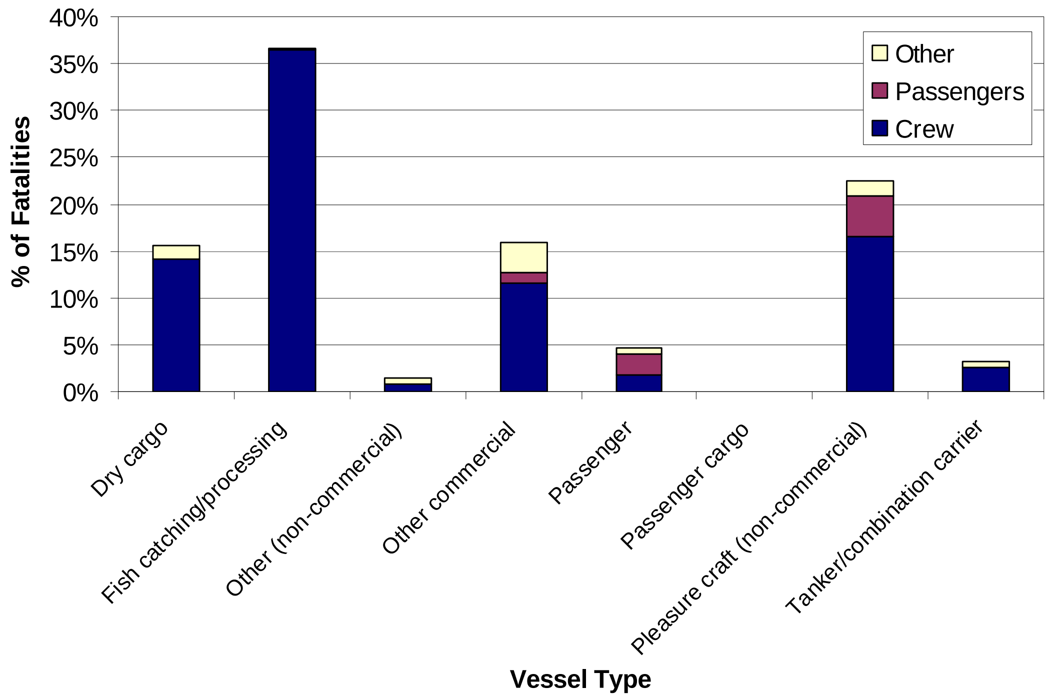

Figure 3.7 Fatalities by Vessel Type for Incidents in UK (MAIB 1994-Sep 2005)

It can be seen that the majority of fatalities in the UK occurred to fishing vessels and pleasure craft, with crew members the main people involved.

3.2 Collision Incidents

MAIB define a collision incident as “vessel hits another vessel that is floating freely or is anchored (as opposed to being tied up alongside).”

A total of 623 collisions were reported to MAIB between 1 January 1994 and 27 September 2005 involving 1,241 vessels (in a handful of cases the other vessel involved was not logged).

The locations of collisions reported in the vicinity of the UK are presented in Figure 3.8.

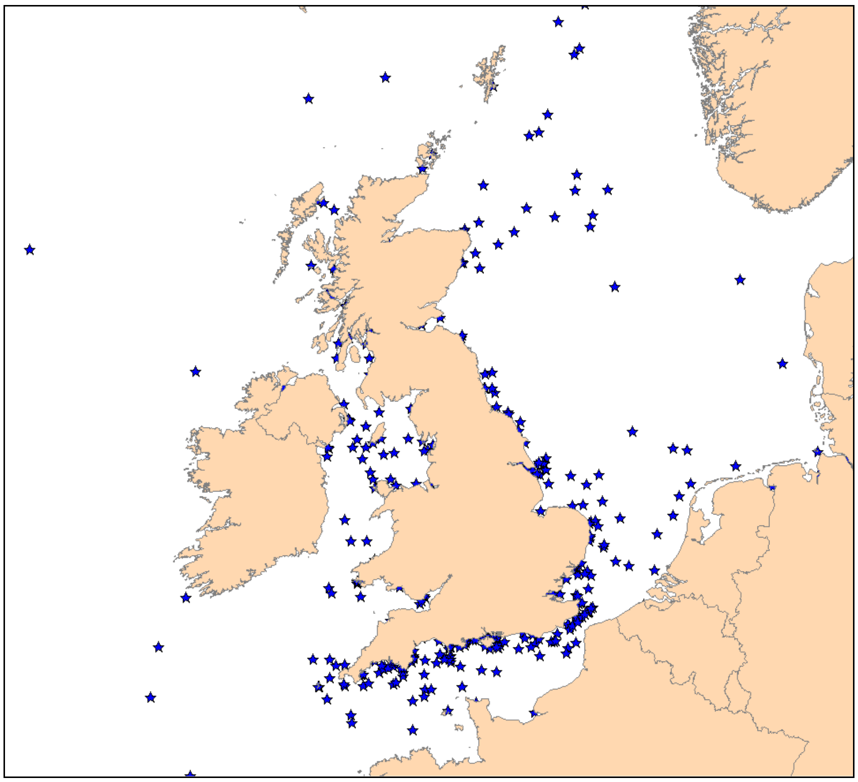

Figure 3.8 Collision Incident Locations (MAIB 1994-Sep 2005)

The distribution of all collision incidents by year is presented in Figure 3.9.

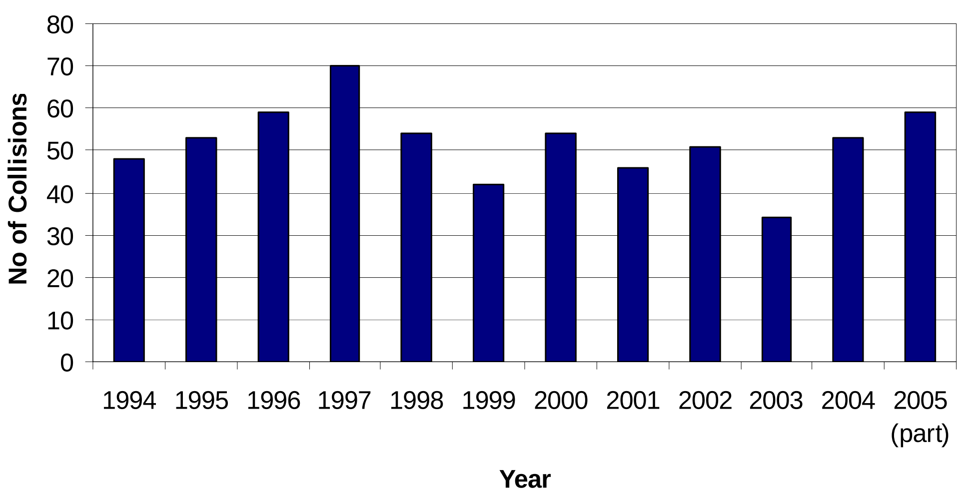

Figure 3.9 Collisions per Year (MAIB 1994-Sep 2005)

The average number of collisions per year, excluding 2005 which is a part-year, was 51.

The distribution of vessel types involved in collisions is presented in Figure 3.10.

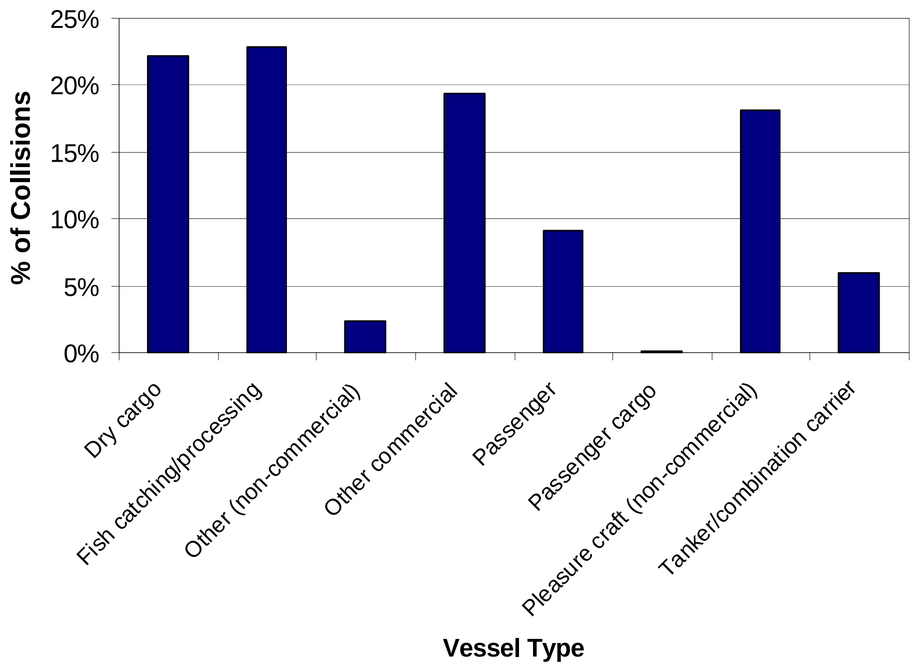

Figure 3.10 Collisions by vessel Type (MAIB 1994-Sep 2005)

Therefore, the most common vessel type involved in collisions were fishing vessels (25%), dry cargo vessels (22%), other commercial vessels (19%) and non-commercial pleasure craft (18%).

Finally, the total number of fatalities per year (divided into crew and passenger) reported in all MAIB collisions is presented in Figure 3.11.

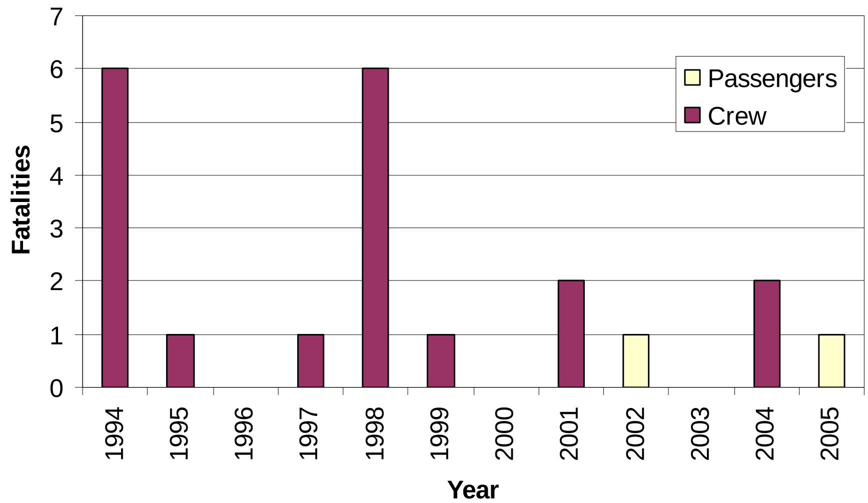

Figure 3.11 Fatalities from Collisions (MAIB 1994-Sep 2005)

The average number of fatalities per year, excluding 2005 which is a part-year, was 1.8.

Details on the 12 incidents reported by MAIB that involved fatalities are presented in Table 3.1. In each case the first vessel listed suffered the losses. It can be seen that most incidents involved fishing vessels and recreational craft.

Table 3.1 Fatal Collision Incidents (MAIB 1994-Sep 2005)

Date	Description	Fatalities
Nov 1994	Beam trawler collision with bulk carrier Foreign waters, high seas, moderate visibility and sea state	6
Jun 1998	Seine netter collision with container ship Foreign waters, high seas, good visibility, moderate seas	5
Feb 1995	Stern trawler collision with supply ship Foreign waters, river/canal, good visibility, moderate seas	1
Mar 1997	Stern trawler collision with other fishing vessel Foreign waters, good visibility, calm seas	1
Jun 1998	RIB collision with other RIB UK territorial waters, river/canal	1
Mar 1999	Fishing vessel collision with container ship Foreign waters, coastal waters, good visibility	1
Aug 2001	Pleasure craft collision with small commercial motor vessel UK territorial waters	1
Oct 2001	General cargo vessel collision with chemical tanker	1

Date	Description	Fatalities
	UK territorial waters, coastal waters, good visibility	
Aug 2002	Speed craft collision with another speed boat UK waters, unspecified location, good visibility, calm seas	1
May 2004	Port service tug collision with passenger ferry (during towing) Foreign waters, coastal waters	1
Jun 2004	Pleasure craft collision with other pleasure craft Foreign waters, river/canal	1
Jul 2005	Pleasure craft collision with (1 passenger fatality) UK territorial waters, coastal waters, good visibility, calm seas	1

A more detailed description of the two incidents which resulted in multiple fatalities is provided below:

- Collision between bulk carrier and beam trawler in eastward lane of Terschelling - German Bight Traffic Separation Scheme (TSS). Both vessels were on passage. Visibility was about 5 miles. Collision caused extensive damage to beam trawler and vessel rapidly flooded and sank with loss of her 6 crew, all of whom were Dutch nationals. Collision was primarily caused by Master of bulk carrier failing to take early and substantial action when complying with his obligation to keep out of the way.

- The fishing vessel was on an easterly course while on passage from Firth of Forth to Esbjerg, and the container ship was on a north-westerly course from Hamburg to Gothenburg. The fishing vessel was the give-way vessel but did not alter course and speed, the cause of which could not be established. The chief officer of the container ship did not alter course until it was too late and the two vessels collided. The fishing vessel foundered so quickly that all hands were trapped inside the accommodation and the container ship was so badly damaged that she had to use Esbjerg as a port of refuge.

3.3 Contact Incidents

MAIB define a contact incident as "vessel hits an object that is immobile and is not subject to the collision regulations e.g. buoy, post, dock (too hard), etc. Also, another ship if it is tied up alongside. Also floating logs, containers etc."

A total of 609 contacts were reported to MAIB between 1 January 1994 and 27 September 2005 involving 663 vessels.

The locations of contacts reported in the vicinity of the UK are presented in Figure 3.12.

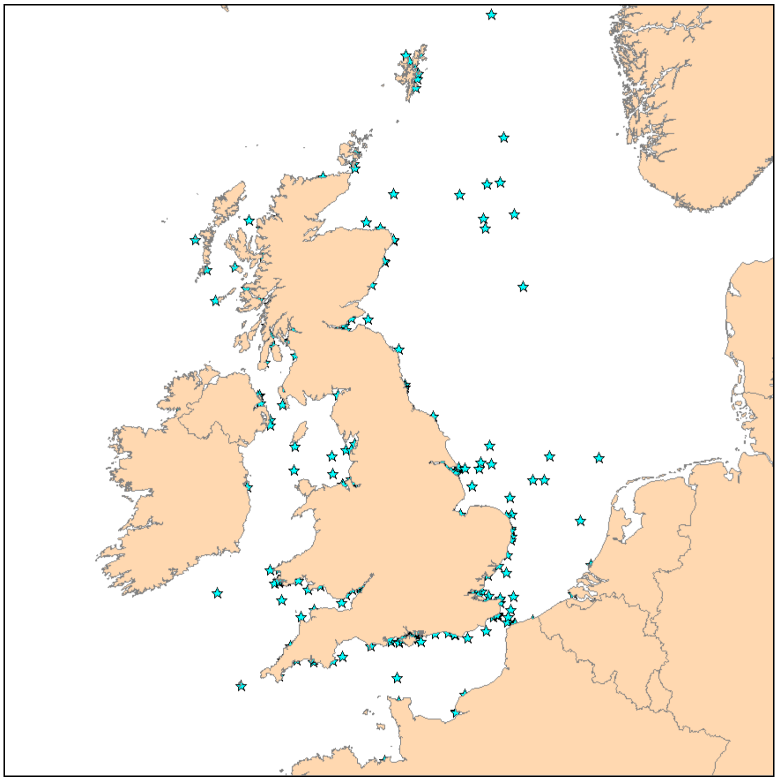

Figure 3.12 Contact Incident Locations (MAIB 1994-Sep 2005)

The distribution of contact incidents by year is presented in Figure 3.13.

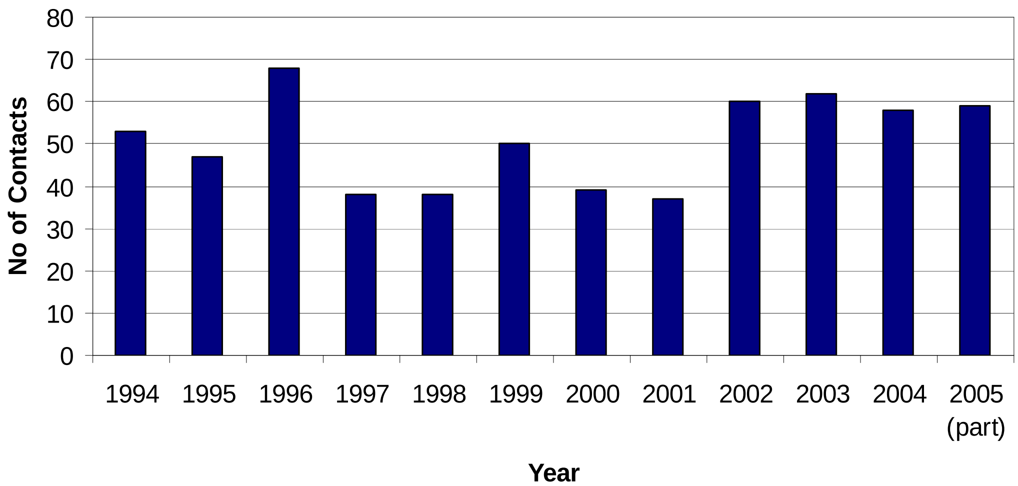

Figure 3.13 Contact Incidents per Year (MAIB 1994-Sep 2005)

The average number of contacts per year, excluding 2005 which is a part-year, was 50.

The distribution of vessel types involved in contacts is presented in Figure 3.14.

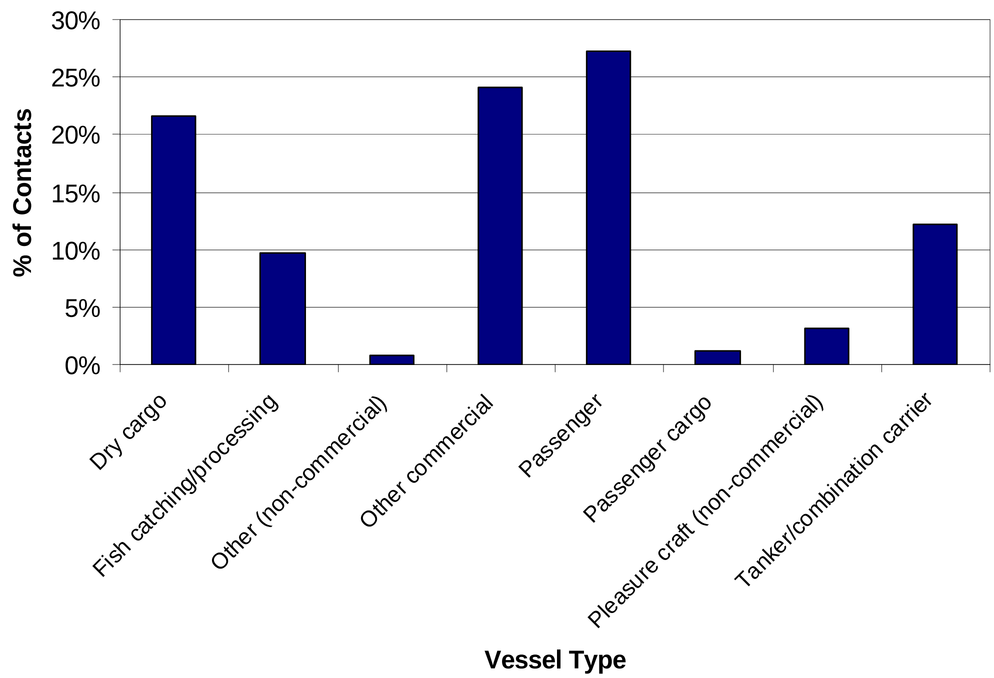

Figure 3.14 Contacts by Vessel Type (MAIB 1994-Sep 2005)

Therefore, the most common vessel type involved in contacts were passenger ferries (27%), other commercial vessels (24%) and dry cargo vessels (22%).

There were no fatalities in any of the contact incidents recorded by MAIB.

G4. Fatality Risk

4.1 Introduction

This section uses the MAIB incident data along with information on average manning levels per vessel type to estimate the probability of fatality in a marine incident associated with the Phase 1 wind farms (Project Alpha and Project Bravo).

The proposed wind farms are assessed to have the potential to affect the following incidents:

- Passing Powered Collision with Wind Farm Structure;
- Passing Drifting Collision with Wind Farm Structure;
- Vessel-to-Vessel Collision; and
- Fishing Vessel Collision with Wind Farm Structure.

Of these incidents, only vessel-to-vessel collisions match the MAIB definition of collisions and hence the fatality analysis presented in Section 3.2 is considered to be directly applicable to these types of incidents.

The other scenarios of passing powered, passing drifting and fishing vessel collisions with the wind farm structures are technically contacts, i.e., vessel hits an immobile object in the form of a turbine or substation. From Section 3.3 it can be seen that none of the 609 contact incidents reported by MAIB between 1994 and 2005 resulted in fatalities.

However, as the mechanics involved in a vessel contacting a wind turbine may differ in severity from hitting, for example, a buoy, quayside or moored vessel, the MAIB collision fatality risk rate has also been conservatively applied for these incidents.

4.2 Fatality Probability

Twelve of the 623 collision incidents reported by MAIB resulted in one or more fatalities. This represents a 2% probability that a collision will lead to a fatal accident. A total of 21 fatalities resulted from the collision incidents.

To assess the fatality risk for personnel on-board a vessel, either crew, passenger or other, the number of persons involved in the incidents needs to be estimated. From an ILO survey of seafarers during 1998-99 (Ref. iii), the average commercial vessel had a crew of 17. For other (non-commercial vessels) such as naval craft and Royal National Lifeboat Institute (RNLI) lifeboats the average crew has been estimated to be 20. On-board fishing vessels and pleasure craft the average crew has been estimated to be 5. Finally, for passenger vessels it is estimated that the average number of passengers carried, in addition to crew, is 300 (based on UK sea passenger movements on principal ferry routes, Ref. iv).

It is recognised these numbers can be substantially higher or lower on an individual vessel basis depending on size, subtype, etc., but applying reasonable averages is considered sufficient for this analysis.

Using the average number of persons carried along with the vessel type information involved in collisions reported by MAIB (see Figure 3.10), gives an estimated 50,000 personnel on-board the ships involved in the collisions.

Based on 21 fatalities, the overall fatality probability in a collision for any individual on-board is approximately 4.3×10^{-4} per collision (0.04%).

It is considered inappropriate to apply this rate uniformly as the statistics clearly shown that the majority of fatalities tend be associated with smaller craft, such as fishing vessels and recreational vessels. Therefore, the fatality probability has been subdivided into two categories of vessel as presented in Table 4.1.

Table 4.1 Fatality Probability per Incident per Vessel Category

Vessel Category	Sub Categories	Fatalities	People Involved	Fatality Probability
Commercial	Dry cargo, passenger, tanker, etc.	3	46,200	6.5E-05
Non-Commercial	Fishing, pleasure, etc.	18	3,120	5.8E-03

From the above table it can be seen the risk is approximately two orders of magnitude higher for people on-board non-commercial vessels.

4.3 Fatality Risk due to Project Alpha

The base case and future case annual collision frequency levels without and with Project Alpha are summarised below.

Table 4.2 Summary of Annual Collision Frequency Results

Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	2.53E-04	2.53E-04	--	2.78E-04	2.78E-04
Passing Drifting	--	3.57E-05	3.57E-05	--	3.93E-05	3.93E-05
Vessel-to-Vessel	5.27E-04	1.02E-03	4.93E-04	5.80E-04	1.12E-03	5.42E-04
Fishing	--	2.05E-02	2.05E-02	--	2.26E-02	2.26E-02
Total	5.27E-04	2.18E-02	2.13E-02	5.80E-04	2.40E-02	2.34E-02

For the local vessels operating in the area of the site, the average manning/persons on-board (POB) has been estimated as follows.

Table 4.3 Vessel types, incidents and average persons exposed

Vessel Type	Collision Incidents	Average Manning/ POB
Cargo/Offshore	Passing powered, passing drifting, vessel-to-vessel.	15
Tanker	Passing powered, passing drifting, vessel-to-vessel.	20
Passenger Ferry	Passing powered, passing drifting, vessel-to-vessel.	2,220
Fishing Vessel	Vessel-to-vessel and fishing.	6
Recreational Vessel	Vessel-to-vessel.	4

From the detailed results of the collision frequency modelling, the distribution of the predicted change in collision frequency by vessel type due to Project Alpha is presented in Figure 4.1.

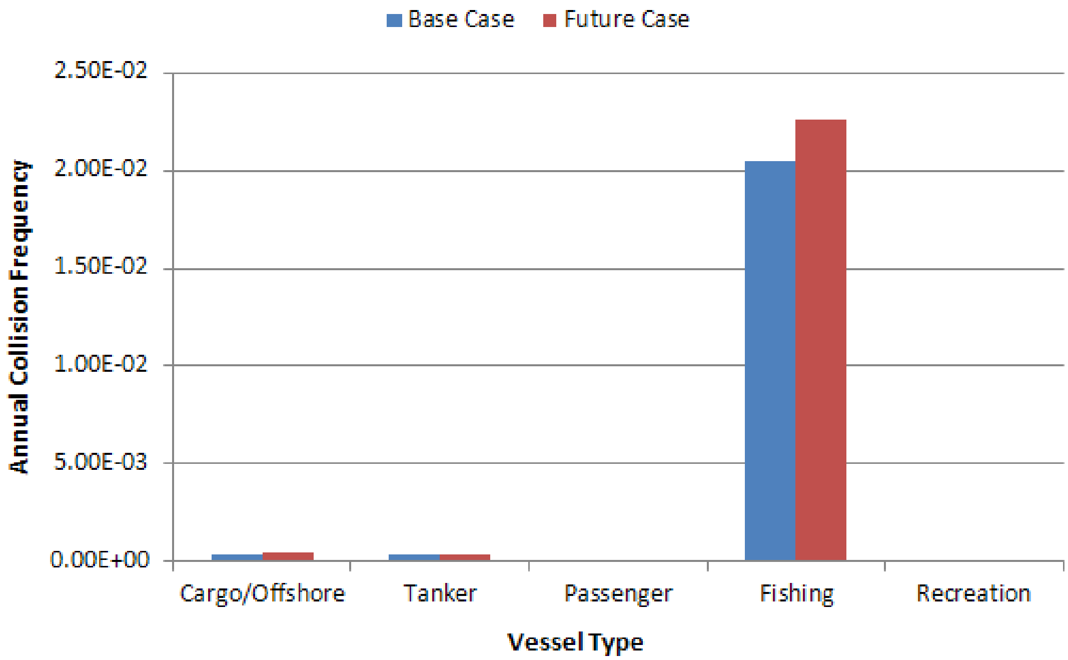

Figure 4.1 Change in Collision by Vessel Type Estimated for Project Alpha

It can be seen that the change in collision frequency is dominated by fishing vessels. The change in frequency is lowest for commercial vessels (cargo/offshore, tankers and ferries) and recreational vessels.

Combining the collision frequency, the estimated number of persons onboard each vessel type (Table 4.3) and the estimated fatality probability for that vessel category (Table 4.1), the annual increase in Potential Loss of Life (PLL) due to the impact of Project Alpha is estimated to be as follows:

- Base Case PLL: 7.13E-04 fatalities per year
- Future Case PLL: 7.85E-04 fatalities per year

The estimated base case PLL increase equates to an average of one additional fatality in 1,402 years, whilst the future case PLL increase corresponds to an average of one additional fatality in 1,274 years.

The predicted incremental increases in PLL due to the wind farm, distributed by vessel type for the base and future cases, are presented in Figure 4.2.

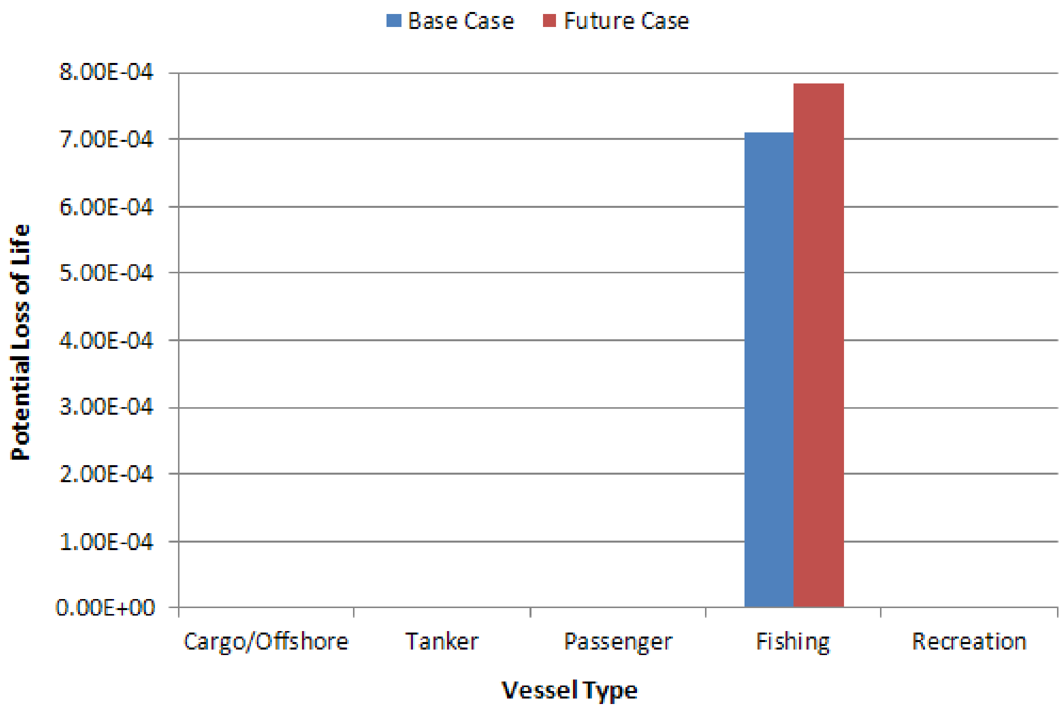

Figure 4.2 Estimated Change in Annual PLL by Vessel Type due to Project Alpha

Therefore, it can be seen that the fatality risk is dominated by fishing vessels, which historically have a higher fatality probability per incident than merchant vessels.

Converting the PLL to individual risk based on the average number of people exposed by vessel type, the results are presented in Figure 4.3. (This calculation assumes that for cargo/offshore vessels, tankers, fishing and recreational vessels, the risk is shared between 10 vessels of each type, which is considered to be conservative based on the number of different vessels operating in the vicinity of the site).

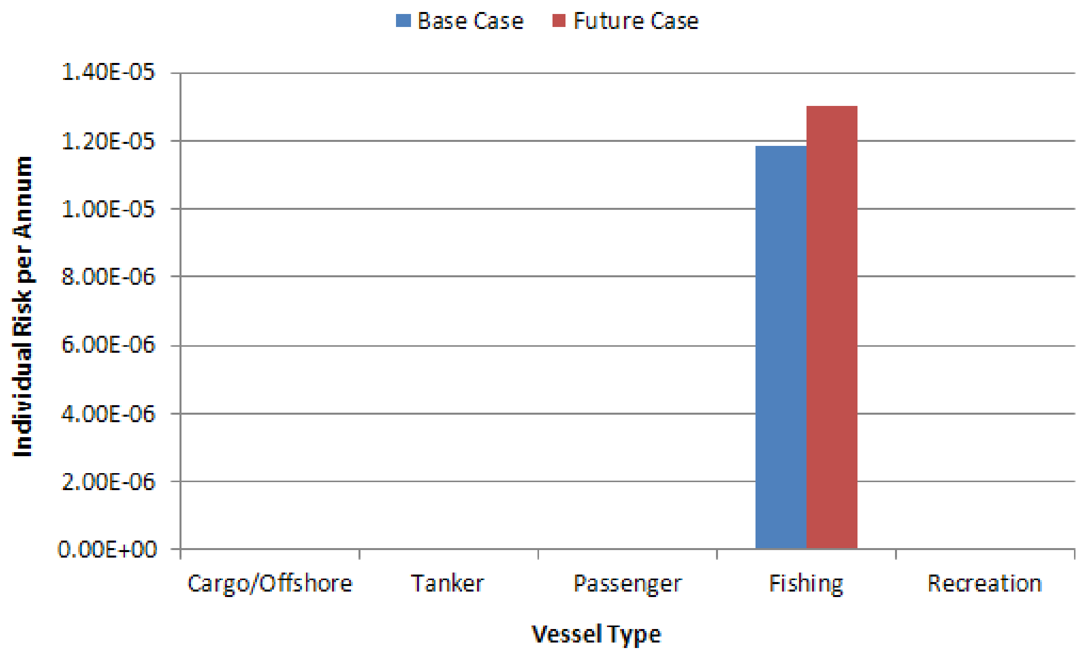

Figure 4.3 Estimated Change in Individual Risk by Vessel Type due to Project Alpha

Therefore, individual risk is highest for people on fishing vessels, which is related to the higher probability of fatalities occurring in the event of an incident.

4.4 Significance of Increase in Fatality Risk – Project Alpha

The overall increase in PLL estimated due to the development is 7.13×10^{-4} fatalities per year (base case), which equates to one additional fatality in 1,402 years. This is a small change compared to the MAIB statistics which indicate an average of 29 fatalities per year in UK territorial waters.

In terms of individual risk to people, the incremental increase for commercial ships (in the region of 10^{-9}) is very low compared to the background risk level for the UK sea transport industry of 2.9×10^{-4} per year.

Similarly, for fishing vessels, whilst the change in individual risk attributed to the development is higher than for commercial vessels (in the region of 10^{-5}), it is relatively low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

4.5 Fatality Risk due to Project Bravo

The base case and future case annual collision frequency levels without and with Project Bravo are summarised below.

Table 4.4 Summary of Annual Collision Frequency Results

Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	4.40E-04	4.40E-04	--	4.84E-04	4.84E-04
Passing Drifting	--	4.26E-05	4.26E-05	--	4.69E-05	4.69E-05
Vessel-to-Vessel	3.23E-04	6.41E-04	3.18E-04	3.55E-04	7.05E-04	3.50E-04
Fishing	--	1.04E-02	1.04E-02	--	1.14E-02	1.14E-02
Total	3.23E-04	1.15E-02	1.12E-02	3.55E-04	1.27E-02	1.23E-02

For the local vessels operating in the area of the site, the average manning/persons on-board (POB) has been estimated as follows.

Table 4.5 Vessel types, incidents and average persons exposed

Vessel Type	Collision Incidents	Average Manning/ POB
Cargo/Offshore	Passing powered, passing drifting, vessel-to-vessel.	15
Tanker	Passing powered, passing drifting, vessel-to-vessel.	20
Passenger Ferry	Passing powered, passing drifting, vessel-to-vessel.	2,220
Fishing Vessel	Vessel-to-vessel and fishing.	6
Recreational Vessel	Vessel-to-vessel.	4

From the detailed results of the collision frequency modelling, the distribution of the predicted change in collision frequency by vessel type due to Project Bravo is presented in Figure 4.4.

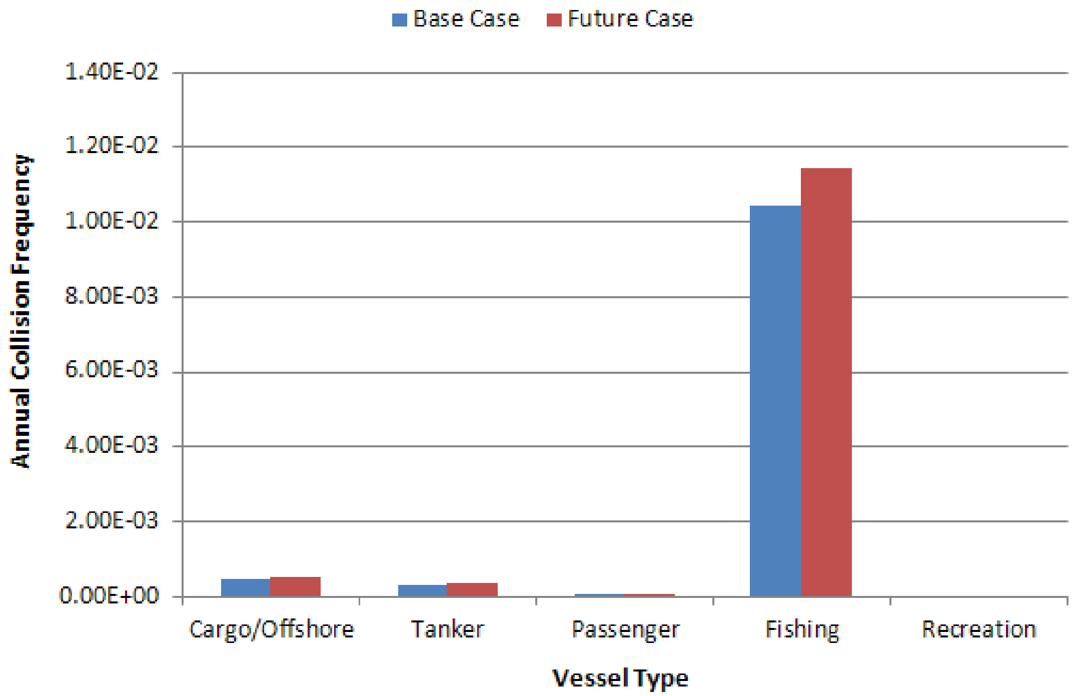

Figure 4.4 Change in Collision by Vessel Type Estimated for Project Bravo

It can be seen that the change in collision frequency is dominated by fishing vessels. The change in frequency is lowest for commercial vessels (cargo/offshore, tankers and ferries) and recreational vessels.

Combining the collision frequency, the estimated number of persons onboard each vessel type (Table 4.5) and the estimated fatality probability for that vessel category (Table 4.1), the annual increase in Potential Loss of Life (PLL) due to the impact of Project Alpha is estimated to be as follows:

- Base Case PLL: 3.62E-04 fatalities per year
- Future Case PLL: 3.99E-04 fatalities per year

The estimated base case PLL increase equates to an average of one additional fatality in 2,759 years, whilst the future case PLL increase corresponds to an average of one additional fatality in 2,509 years.

The predicted incremental increases in PLL due to the wind farm, distributed by vessel type for the base and future cases, are presented in Figure 4.5.

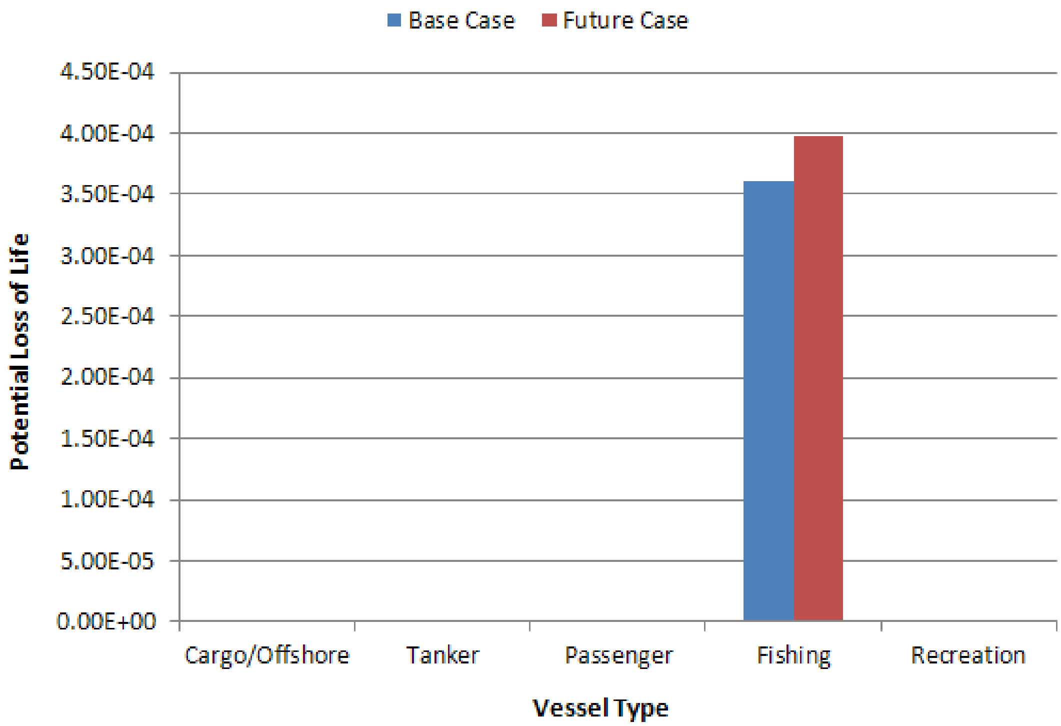

Figure 4.5 Estimated Change in Annual PLL by Vessel Type due to Project Bravo

Therefore, it can be seen that the fatality risk is dominated by fishing vessels, which historically have a higher fatality probability per incident than merchant vessels.

Converting the PLL to individual risk based on the average number of people exposed by vessel type, the results are presented in Figure 4.6. (This calculation assumes that for cargo/offshore vessels, tankers, fishing and recreational vessels, the risk is shared between 10 vessels of each type, which is considered to be conservative based on the number of different vessels operating in the vicinity of the site).

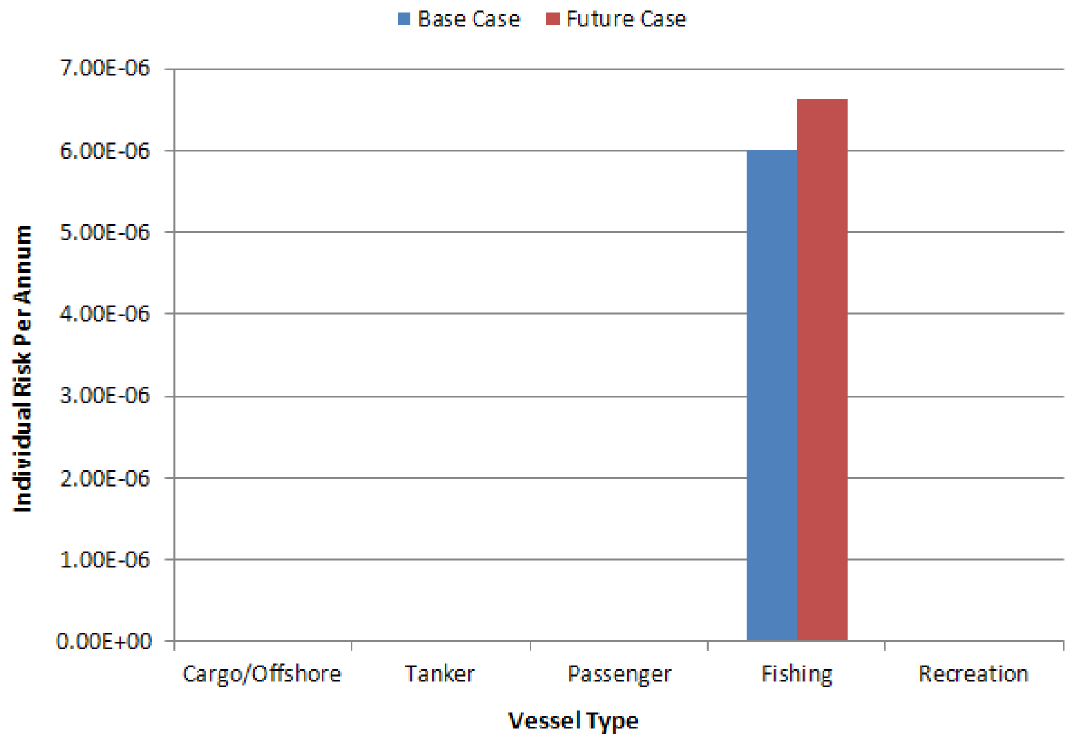

Figure 4.6 Estimated Change in Individual Risk by Vessel Type due to Project Bravo

Therefore, individual risk is highest for people on fishing vessels, which is related to the higher probability of fatalities occurring in the event of an incident.

4.6 Significance of Increase in Fatality Risk – Project Bravo

The overall increase in PLL estimated due to the development is 3.62 x 10^{-4} fatalities per year (base case), which equates to one additional fatality in 2,759 years. This is a small change compared to the MAIB statistics which indicate an average of 29 fatalities per year in UK territorial waters.

In terms of individual risk to people, the incremental increase for commercial ships (in the region of 10^{-9}) is very low compared to the background risk level for the UK sea transport industry of 2.9 x 10^{-4} per year.

Similarly, for fishing vessels, whilst the change in individual risk attributed to the development is higher than for commercial vessels (in the region of 10^{-6}), it is relatively low compared to the background risk level for the UK sea fishing industry of 1.2 x 10^{-3} per year.

G5. Pollution Risk

5.1 Historical Analysis

The pollution consequences of a collision in terms of oil spill depend on the following:

- Spill probability (i.e., likelihood of outflow following an accident)
- Spill size (amount of oil)

Two types of oil spill are considered:

- Fuel oil spills from bunkers (all vessel types)
- Cargo oil spills (laden tankers)

The research undertaken as part of the DfT's Marine Environmental High Risk Areas (MEHRAs) project (Ref. v) has been used as it was comprehensive and based on worldwide marine spill data analysis.

From this research, the overall probability of a spill per accident was calculated based on historical accident data for each accident type as presented in Figure 5.1.

Figure 5.1 Probability of an Oil Spill Resulting from an Accident

Therefore, it was estimated that 13% of ship collisions result in a fuel oil spill and 39% of collisions involving a laden tanker result in a cargo oil spill.

In the event of a bunker spill, the potential outflow of oil depends on the bunker capacity of the vessel. Historical bunker spills from ships have generally been limited to a size below 50% of the bunker capacity, and in most incidents much lower. For the types and sizes of ships exposed to the site, an average spill size of 100 tonnes of fuel oil is considered to be a conservative assumption.

For cargo spills from laden tankers, the spill size can vary significantly. International Tanker Owners Pollution Federation limited (ITOPF) report the following spill size distribution for tanker collisions between 1974 and 2004.

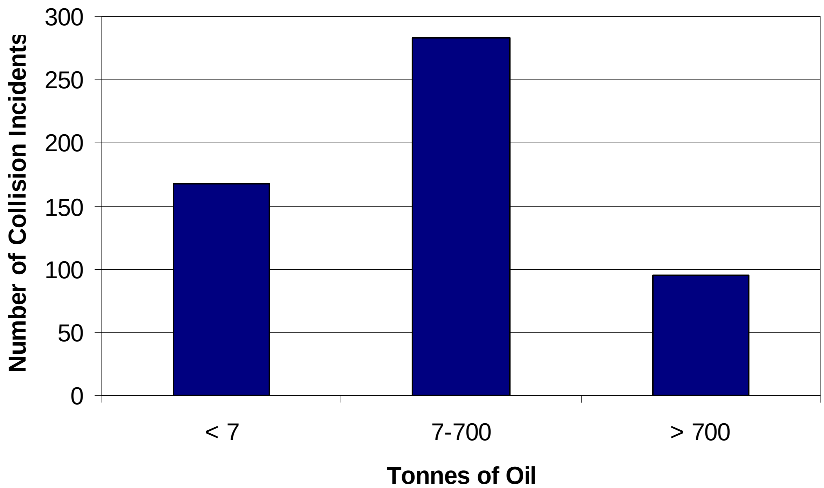

Figure 5.2 Spill Size Distribution in Tanker Collision Incidents (ITOPF 1974-2004)

31% of spills are below 7 tonnes, 52% are between 7 and 700 tonnes and 17% are greater than 700 tonnes. Based on this data and the tankers transiting the area in proximity to the proposed wind farms, an average spill size of 400 tonnes is considered conservative.

For fishing and recreational vessel collisions/allisions, comprehensive statistical data is not available so it is conservatively assumed that 50% of all collisions involving these vessels will lead to oil spill with the quantity spilled being an average of 5 tonnes for fishing vessels and 1 tonne for recreational vessels.

5.2 Pollution Risk – Project Alpha

Applying the above probabilities to the collision frequency by vessel type presented in Figure 4.1 and the average spill size per vessel, the amount of oil spilled per year due to the impact of Project Alpha is estimated to be as follows:

- Base Case: 0.11 tonnes of oil per year
- Future Case: 0.12 tonnes of oil per year

The predicted increases in tonnes of oil spilled, distributed by vessel type, is presented in Figure 5.3.

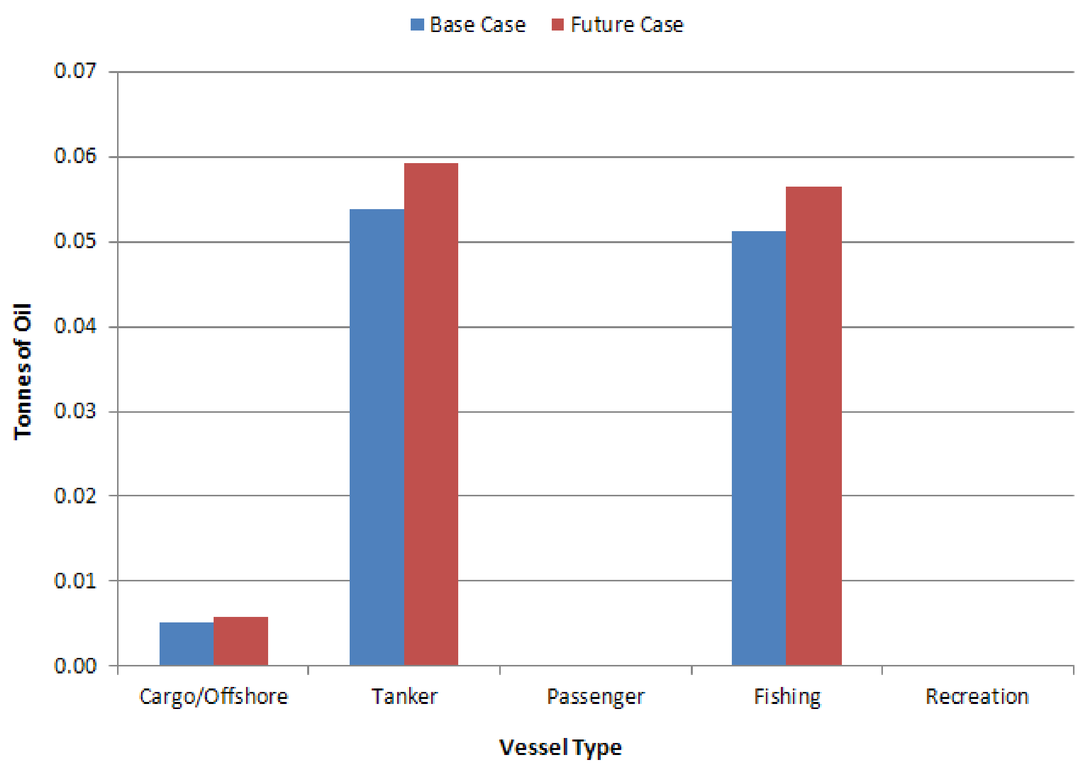

Figure 5.3 Estimated Change in Pollution by Vessel Type due to Project Alpha

It can be seen that tankers, which can spill both fuel and cargo oils, contribute a large proportion of the overall risk of oil spill. Fishing vessels are also a significant contributor given the high annual collision frequency for the proposed development.

5.3 Significance of Increase in Pollution Risk – Project Alpha

To assess the significance of the increased pollution risk from marine vessels caused by Project Alpha, historical oil spill data for the UK has been used as a benchmark.

From the MEHRAs research (Ref. v); the average annual tonnes of oil spilled in the waters around the British Isles due to marine accidents in the 10-year period from 1989-98 1998 was 16,111. This is based on a total of 146 reported oil pollution incidents of greater than 1 tonne (smaller spills are excluded as are incidents which occurred within port and harbour areas or as a result of operational errors or equipment failure). Merchant vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

The overall increase in pollution estimated due to Project Alpha is very low compared to the historical average pollution quantities from marine accidents in UK waters (approximately 0.00069%).

5.4 Pollution Risk – Project Bravo

Applying the above probabilities to the collision frequency by vessel type presented in Figure 4.4 and the average spill size per vessel, the amount of oil spilled per year due to the impact of Project Bravo is estimated to be as follows:

- Base Case: 0.08 tonnes of oil per year
- Future Case: 0.09 tonnes of oil per year

The predicted increases in tonnes of oil spilled, distributed by vessel type, is presented in Figure 5.4.

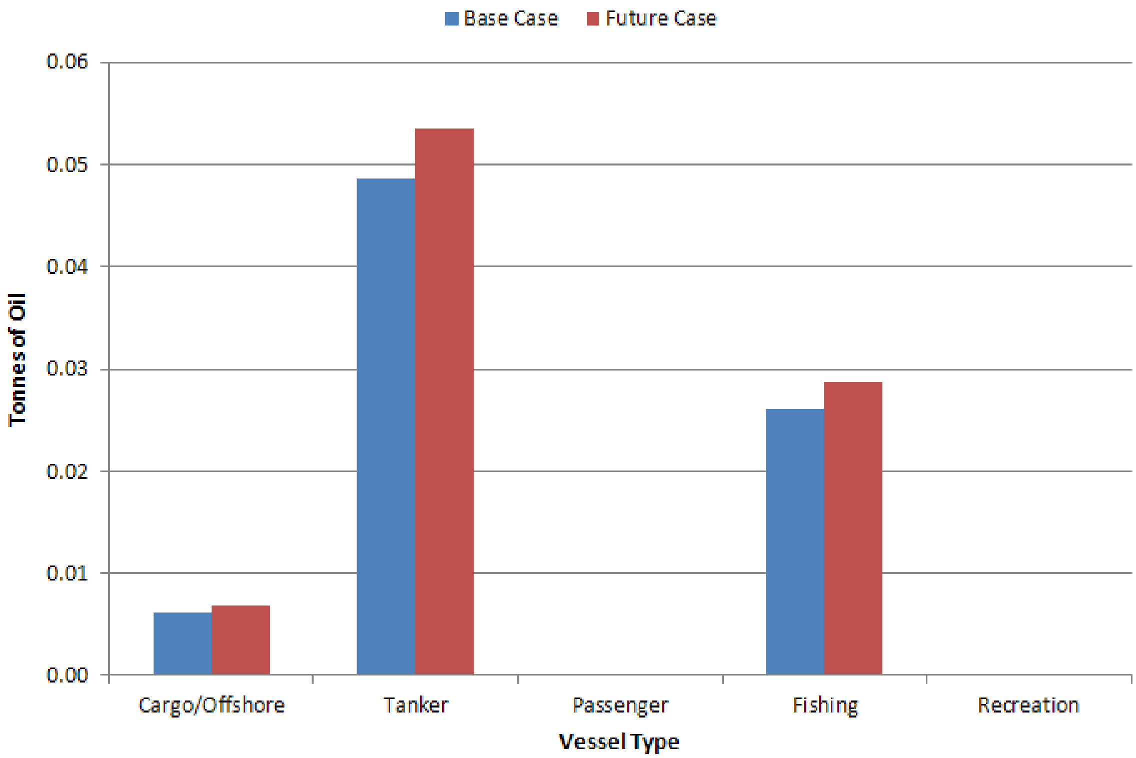

Figure 5.4 Estimated Change in Pollution by Vessel Type due to Project Bravo

It can be seen that tankers, which can spill both fuel and cargo oils, contribute a large proportion of the overall risk of oil spill. Fishing vessels are also a significant contributor given the high annual collision frequency for the proposed development.

5.5 Significance of Increase in Pollution Risk – Project Bravo

To assess the significance of the increased pollution risk from marine vessels caused by Project Bravo, historical oil spill data for the UK has been used as a benchmark.

From the MEHRAs research (Ref. v); the average annual tonnes of oil spilled in the waters around the British Isles due to marine accidents in the 10-year period from 1989-98 1998 was 16,111. This is based on a total of 146 reported oil pollution incidents of greater than 1 tonne (smaller spills are excluded as are incidents which occurred within port and harbour areas or as a result of operational errors or equipment failure). Merchant vessel spills accounted for approximately 99% of the total while fishing vessel incidents accounted for less than 1%.

The overall increase in pollution estimated due to Project Bravo is very low compared to the historical average pollution quantities from marine accidents in UK waters (approximately 0.00050%).

G6. Conclusions

The quantitative risk assessment indicates that the impact of the proposed Phase 1 wind farms (Project Alpha and Project Bravo) on people and the environment is relatively low compared to background risk levels in UK waters.

However, it is recognised that there is a degree of uncertainty associated with numerical modelling. For example, the model does not consider the potential radar interference from turbines which may have an influence on the risk of vessel-to-vessel collisions, especially in reduced visibility where one or both of the vessels involved is not carrying Automatic Identification System (AIS). Therefore, conservative assumptions have been applied in this analysis and the overall project is being carried out based on the principle of ALARP to ensure the risks to people and the environment are managed to a level that is as low as reasonably practicable.

It should also be noted that this is the localised impact of Project Alpha and Project Bravo only and there will be additional maritime risks associated with other offshore wind farm projects in the outer Forth and Tay region as a whole.

G7. References

i IMO Maritime Safety Committee, 74th Edition, Agenda Item 5 (MSC 74/5/X), Bulk Carrier Safety – Formal Safety Assessment, 2001.

ii MCA "Safety Information – FSA, Statistical Data" web page.

iii International Labour Organisation, The Impact on Seafarers' Living and Working Conditions of Changes in the Structure of the Shipping Industry, Geneva 2001, JMC/29/2001/3.

iv Department for Transport Maritime Statistics 2004.

v Department for Transport, Identification of Marine Environmental High Risk Areas (MEHRA's) in the UK, 2001.