NRA and Shipping and Navigation ES Chapter

Navigation Risk Assessment Hywind Scotland Pilot Park Project

Statoil ASA

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Integrated Services
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Navigation Risk Assessment

Hywind Scotland
Pilot Park Project

(Technical Note)

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On behalf of:	Xodus Group Limited on behalf of Hywind Scotland Limited
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Abbreviations

AC	-	Alternating Current
AfL	-	Agreement for Lease
AIS	-	Automatic Information Systems
ALARP	-	As Low As Reasonably Practicable
ALB	-	All-Weather Lifeboat
AOWFL	-	Aberdeen offshore Wind Farm Limited
AREG	-	Aberdeen Renewable Energy Group
ARPA	-	Automatic Radar Plotting Aid
ATBA	-	Area to Be Avoided
AtoN	-	Aids to Navigation
BATNEC	-	Best Available Technology Not at Excessive Cost
BERR	-	Department for Business Enterprise and Regulatory Reform
BMAPA	-	British Marine Aggregate Producers Association
BPI	-	Burial Protection Index
BTA	-	British Tugowners Association
BWEA	-	British Wind Energy Association (now RenewableUK)
CA	-	Cruising Association
CAA	-	Civil Aviation Authority
CAST	-	Coastguard Agreement on Salvage and Towage
CBA	-	Cost Benefit Assessment
CCTV	-	Closed-Circuit Television
CIA	-	Cumulative Impact Assessment
CNIS	-	Channel Navigation Information Service
COLREGS	-	International Regulations for Preventing Collisions at Sea
Db	-	Decibels
DECC	-	Department of Energy and Climate Change
DfT	-	Department for Transport
DSC	-	Digital Selective Calling
EERA	-	Evacuation, Escape and Rescue Analysis
EIA	-	Environmental Impact Assessment
EOWDC	-	European Offshore Wind Deployment Centre
ERCoP	-	Emergency Response Cooperation Plan
ERRV	-	Emergency Response and Rescue Vessel
ESAS	-	European Seabirds at Sea
ETV	-	Emergency Towing Vessel
FSA	-	Formal Safety Assessment
GCAF	-	Gross Cost of Averting a Fatality
GIS	-	Geographical Information Systems
GPS	-	Global Positioning Systems
GRP	-	Glass Reinforced Plastic
GRT	-	Gross Registered Tonnage
HAT	-	Highest Astronomical Tide
HF	-	High Frequency
HMCG	-	Her Majesty's Coastguard

HSE	-	Health and Safety Executive
HSL	-	Hywind Scotland Limited
IALA	-	International Association of Marine Aids to Navigation and Lighthouses
IMO	-	International Maritime Organisation
IPC	-	Infrastructure Planning Commission
IPS	-	Intermediate Peripheral Structure
kHz	-	kiloHertz
km	-	kilometre
kV	-	kilovolt
LAT	-	Lowest Astronomical Tide
m	-	metre
MAIB	-	Marine Accident Investigation Branch
MBS	-	Maritime Buoyage System
MCA	-	Maritime and Coastguard Agency
MDA	-	Managed Defence Area
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
MoD	-	Ministry of Defence
MRCC	-	Maritime Rescue Coordination Centre
MRSC	-	Maritime Rescue Sub Centre
MSF	-	Marine Safety Forum
MSL	-	Mean Sea Level
MW	-	megawatt
NLB	-	Northern Lighthouse Board
nm	-	nautical mile
NOREL	-	Nautical and Offshore Renewable Energy Liaison
NRA	-	Navigational Risk Assessment
OREI	-	Offshore Renewable Energy Installation
PHA	-	Preliminary Hazard Analysis
PLA	-	Port of London Authority
PLL	-	Potential Loss of Life
PLN	-	Port Letter Number
PPE	-	Personal Protective Equipment
RAF	-	Royal Air Force
REZ	-	Renewable Energy Zones
RNLI	-	Royal National Lifeboat Institution
ROV	-	Remotely Operated underwater Vehicle
RUK	-	RenewablesUK
RYA	-	Royal Yachting Association
SAR	-	Search and Rescue

SFF	-	Scottish Fishermen's Federation
SOSREP	-	Secretary of States' Representative for Salvage and Intervention
SPS	-	Significant Peripheral Structure
TCE	-	The Crown Estate
THLS	-	Trinity House Lighthouse Service
TSS	-	Traffic Separation Scheme
UHF	-	Ultra High Frequency
UK	-	United Kingdom
UKCS	-	United Kingdom Continental Shelf
UKHO	-	United Kingdom Hydrographic Office
UTM	-	Universal Transverse Mercator
VHF	-	Very High Frequency
VTS	-	Vessel Traffic Service
WGS	-	World Geodetic System
WTG	-	Wind Turbine Generator

1. INTRODUCTION

1.1 Background

Anatec was commissioned by Xodus Group Ltd on behalf of Hywind Scotland Limited (HSL) (hereafter referred to as 'Statoil') to perform a shipping and navigation assessment of the proposed Hywind Scotland Pilot Park Project in Buchan Deep off Peterhead.

The report presents information on the proposed development relative to the baseline navigational activity and features for the area. Following this, an assessment of the impact of the proposed development on navigation is presented. The assessment forms part of the Environmental Impact Assessment (EIA).

1.2 Navigational Risk Assessment Purpose

An EIA is a process which identifies the environmental effects, both negative and positive, in accordance with EU Directives. A key requirement of the EIA is the Navigational Risk Assessment (NRA). Following the Department of Energy and Climate Change (DECC) Methodology and Marine Guidance Notice (MGN 371), an NRA for the Project has been undertaken and includes:

- Overview of base case environment;
- Maritime traffic survey;
- Implications of Offshore Renewable Energy Installations (OREIs);
- Assessment of navigational risk pre and post development of the proposed Hywind Scotland Pilot Park Project;
- Formal Safety Assessment (FSA);
- Implications on marine navigation and communication equipment;
- Identification of mitigation measures;
- Search and Rescue (SAR) planning; and
- Through life safety management.

The assessment reviews the following phases:

- Pre-construction;
- Construction;
- Operation and maintenance; and
- Decommissioning.

1.3 NRA Methodology

Figure 1.1 shows an overview of the NRA methodology which was used in this study. This methodology was designed to meet the guidance described in Section 2.

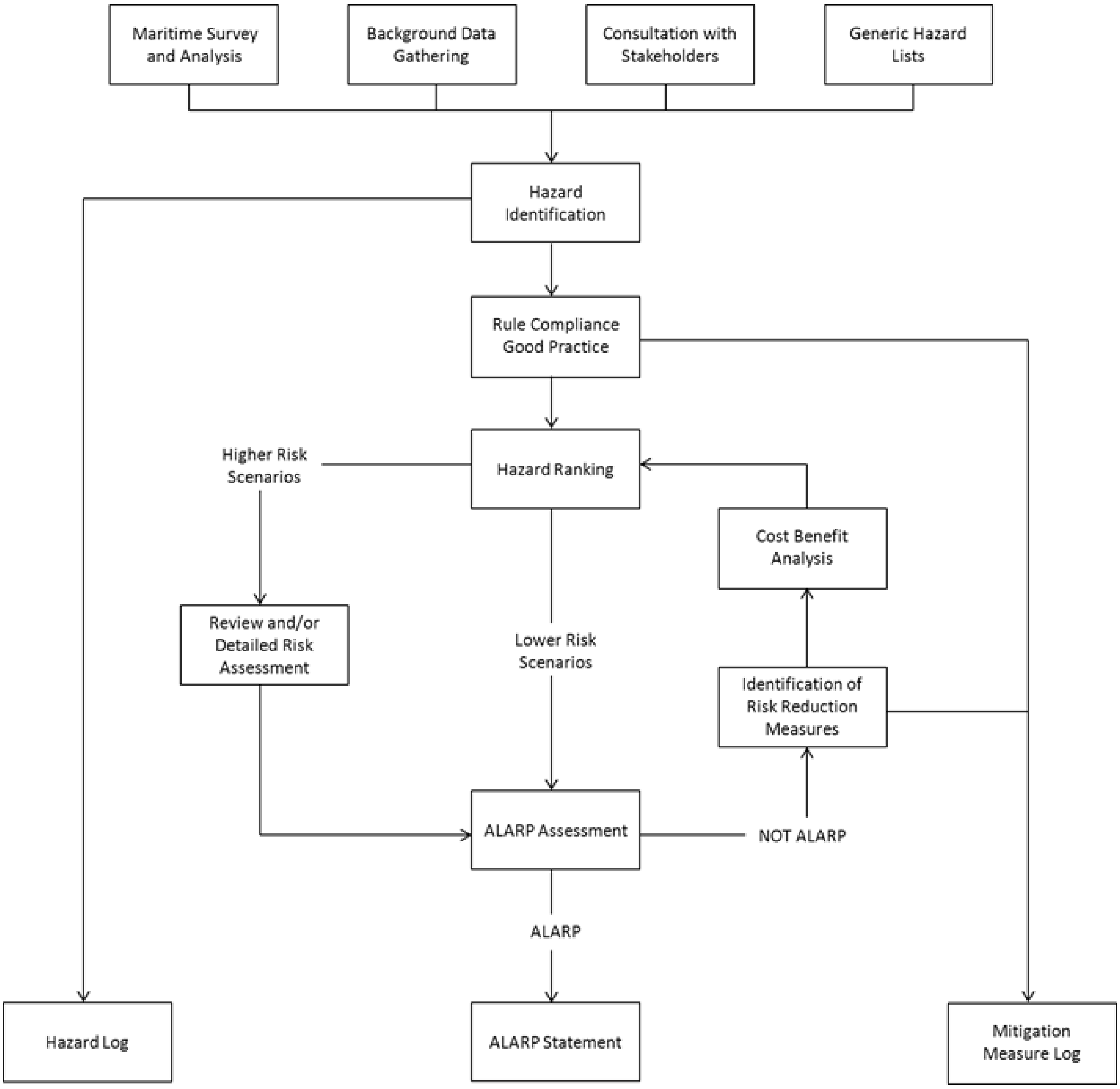


Figure 1.1 Overview of Methodology for Navigational Assessment

2. GUIDANCE, LEGISLATION AND CONSULTATION

2.1 Primary Guidance

The primary guidance documents used during the assessment are listed below:

- Maritime and Coastguard Agency (MCA) Marine Guidance Notice 371 (MGN 371 Merchant + Fishing) Offshore Renewable Energy Installations (OREIs) Guidance on UK Navigational Practice, Safety and Emergency Response Issues (MCA, 2008a):
- Department of Energy and Climate Change (DECC) in Association with MCA Guidance on the Assessment of Offshore Wind Farms - Methodology for Assessing Marine Navigational Safety Risks of Offshore Wind Farms (DECC, 2005); and
- International Maritime Organisation (IMO) Guidelines for Formal Safety Assessment (FSA) – MSC/Circ. 1023 (IMO, 2002).

2.2 MCA Marine Guidance Notice 371

MGN 371 highlights issues to be taken into consideration when assessing the effect on navigational safety from offshore renewable energy developments proposed within United Kingdom internal waters, territorial sea or Renewable Energy Zones (REZ).

MGN 371 contains five annexes 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.
- 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 C.

2.3 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) (DECC, 2005).

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 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 (DECC, 2005)

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

2.4 Formal Safety Assessment Process

The IMO Formal Safety Assessment process (IMO, 2002) 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 analysis (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 analysis (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 2.1 is a flow diagram of the FSA methodology applied.

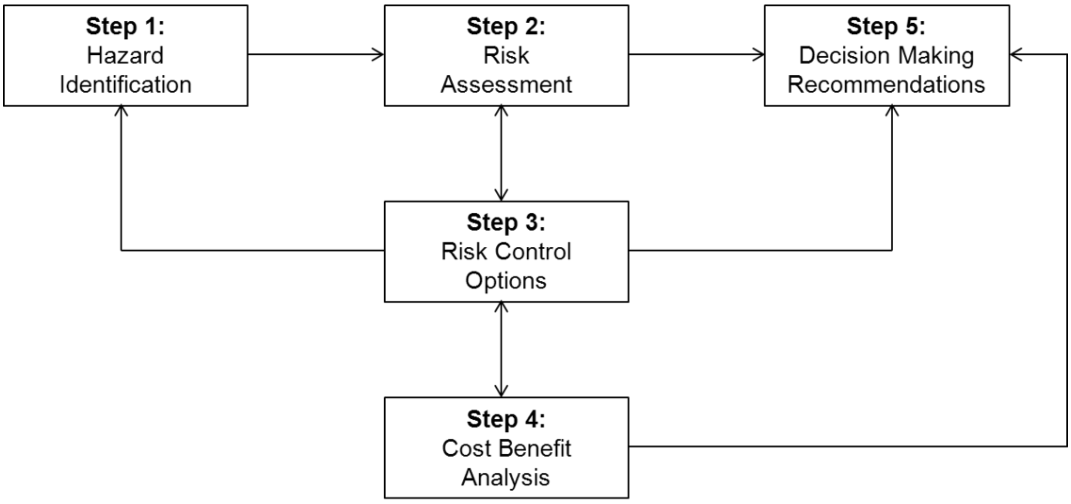


Figure 2.1 Formal Safety Assessment Process

The impact assessment uses information within the baseline assessment to assess impacts as per the Formal Safety Assessment process.

- Hazard log and risk ranking;
- Quantified navigational risk assessment for selected hazards;
- Base case and future case risk levels assessed for selected hazards;
- Emergency response review; and
- Assessment of mitigation measures.

The main part of the impact assessment covers the potential impacts to commercial vessels, fishing vessels and recreational vessels from the construction / installation and presence of the proposed offshore wind farm and associated infrastructure including the offshore export cable. The impacts on emergency response, marine radar systems and navigational equipment are assessed.

2.5 MCA Wind Farm: "Shipping Route" Template

A trial performed by the Maritime & Coastguard Agency at the North Hoyle OWF (MCA and QinetiQ, 2004) indicated that turbines 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 (British Wind Energy Association (BWEA), 2007). The onset range from the turbines of these returns is about 1.5nm, with a progressive deterioration in the radar picture as the turbines are closed to about 500 metres. 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 Windfarm Shipping Route Template (MCA, 2008a), reproduced in Figure 2.2, indicates that turbines 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 2.3.

Marine traffic survey information collected for the Hywind Scotland Pilot Park Project 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 2.2 Windfarm "Shipping Route" Template (MCA, 2008a)

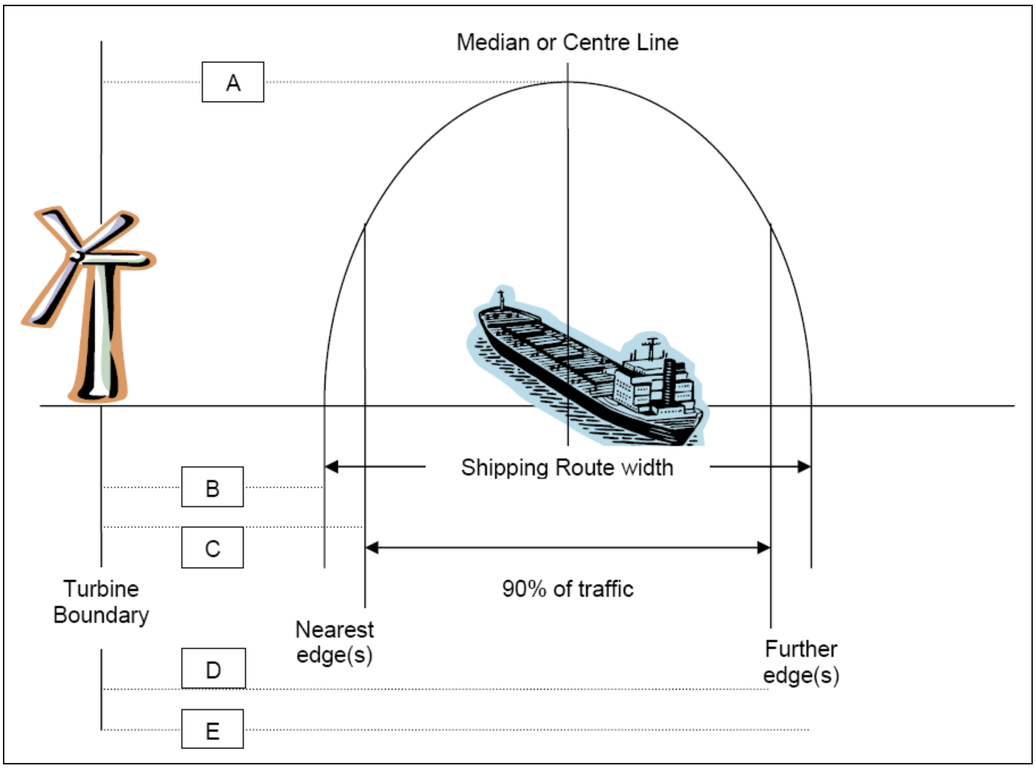


Figure 2.3 Interactive Boundaries (require Interpretative Flexibility) where:

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

2.6 IALA

The wind farm will need to be marked according to IALA guidelines (IALA, 2013). 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 phases of construction, operation and decommissioning will be agreed with the NLB.

2.7 Other Guidance

Other guidance documents used during the assessment are listed below:

- MCA Marine Guidance Notice 372 (MGN 372 M+F) Offshore Renewable Energy Installations (OREIs) Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2008b);
- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) – 0-139 the Marking of Man-Made Offshore Structures, Edition 2 IALA (2013);

- Royal Yachting Association (RYA) – The RYA's Position on Offshore Renewable Energy Developments: Paper 1 – Wind Energy (RYA, 2013);
- DECC Standard Marking Schedule for Offshore Installations (DECC, 2011); and
- The Recreational Craft Directives 94/25/EC and 2003/44/EC - implemented into UK law by the Recreational Craft Regulations 2004 (SI No. 2004/1464), apply to recreational craft and are intended to ensure the free movement of goods on the EEA market.

2.8 Stakeholder Consultation

A range of stakeholders were consulted during the NRA process. This included the preparation of a Preliminary Hazard Analysis report which was included in the Scoping Report to Marine Scotland and therefore covered within the Scoping Opinion. A Hazard Review Workshop was also held involving a cross-section of local stakeholders identified from the baseline data.

3. MARINE NAVIGATIONAL MARKINGS

3.1 Introduction

Throughout the project, marine navigational marking will be provided in accordance with NLB requirements, which will comply with IALA Recommendation O-139 on the Marking of Offshore Wind Farms (IALA, 2013) and the additional requirements of MCA MGN 371 (M+F) (MCA, 2008a). Civil Aviation Authority (CAA) requirements will also be followed.

General details on typical requirements are presented below.

3.2 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).

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.

3.3 Marking of Individual Structures

The sections of the Hywind Scotland WTG Units located above the sea surface will be pale grey with a semi-matt finish. For the purposes of navigational safety, the upper parts of the WTG Unit substructure (at sea level) and splash zone will be painted yellow to provide increased visibility to shipping.

As per the MCA requirements, each of the structures will be marked with clearly visible unique identification characteristics at a location that is easily and readily serviceable. The identifications characteristics 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 3mabove sea levels, and at a distance of at least 150m from the turbine. The light will be either hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation marks.

3.4 Proposed Markings

The markings for the Hywind Scotland Pilot Park Project will be agreed in consultation with NLB once the final WTG Unit layout has been selected. As per IALA guidelines, it is likely that:

- 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 Unit 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 Unit towers are to be coloured yellow from at least HAT to 15m or the height of the lights (the equivalent height on the unlighted structures), whichever is greater.

3.5 Superintendence and Management

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

4. DATA SOURCES

4.1 Introduction

This section summarises and describes the main data sources used in assessing the baseline shipping activities relative to the Hywind Scotland Pilot Park Project.

4.2 Baseline Data Summary

The main data sources used in this assessment are listed below:

- Maritime Traffic Survey Data – 4 x 28 Days Shore-based. (At the time of the 2013-14 AIS surveys, AIS carriage was mandatory for fishing vessels ≥ 18m length under EU Directive.)
  - 28 Days Summer 2013;
  - 28 Days Autumn 2013;
  - 28 Days Winter 2014; and
  - 28 Days Spring 2014.

- Raw vessel data from European Seabirds at Sea (ESAS) surveys.
  - June 2013 to May 2014.

- Manual radar vessel traffic survey during *Franklin* geophysical survey.
  - 6 to 28 August 2013.

- Fishing Data.
  - Sightings data for 2008-2012, from Marine Scotland Compliance.
  - Satellite vessel monitoring system (VMS) data for 2011-2012, from Marine Management Organisation (MMO). (Satellites record the positions of fishing vessels of 15m length and over a minimum of every two hours.)

- Maritime Incident Data.
  - Marine Accident Investigation Branch (MAIB) data for 2003-2012.
  - Royal National Lifeboat Institution (RNLI) data for 2001-2010.

- UK Coastal Atlas of Recreational Boating (2009) and Geographic Information Systems (GIS) Shapefiles (RYA, 2010).

- Oil & Gas Platforms (UK Deal, 2014).

- Offshore Renewables shapefiles (TCE, 2014).

- Marine aggregate dredging data.
  - Aggregate Dredging Licence and Active Areas shapefiles (TCE, 2014); and
  - British Marine Aggregate Producers Association (BMAPA) aggregates dredger transit routes.

- Marine Environmental High Risk Areas (MEHRA) (DfT, 2006).

- Admiralty Sailing Directions – North Sea (West) Pilot, NP 54 (United Kingdom Hydrographic Office (UKHO), 2009).

- UK Admiralty Charts:
  - 1409_0 Buckie to Arbroath;
  - 1438_1 Approaches to Peterhead; and
  - 1446_1 Approaches to Aberdeen.

4.3 Maritime Traffic Survey

Baseline shipping activity was assessed using Automatic Information System (AIS) track data. Data were analysed for four periods which encompassed seasonal fluctuations in shipping activity and accounted for a range of tidal conditions.

A 10nm buffer surrounding the initial Exclusivity Area was used for analysis of the AIS data, hereafter referred to as the Pilot Park Study Area. This area was revised as work on the Project progressed and a slightly modified Agreement for Lease (AfL) area awarded to Statoil but this does not significantly affect the findings of the AIS analysis in terms of number of intersections, etc. The Pilot Park Study Area covers at least 10nm around the Northern AfL area. Figure 4.1 presents the Pilot Park Study Area used for analysis within the NRA. The proposed export cable route to shore was covered by a separate study area.

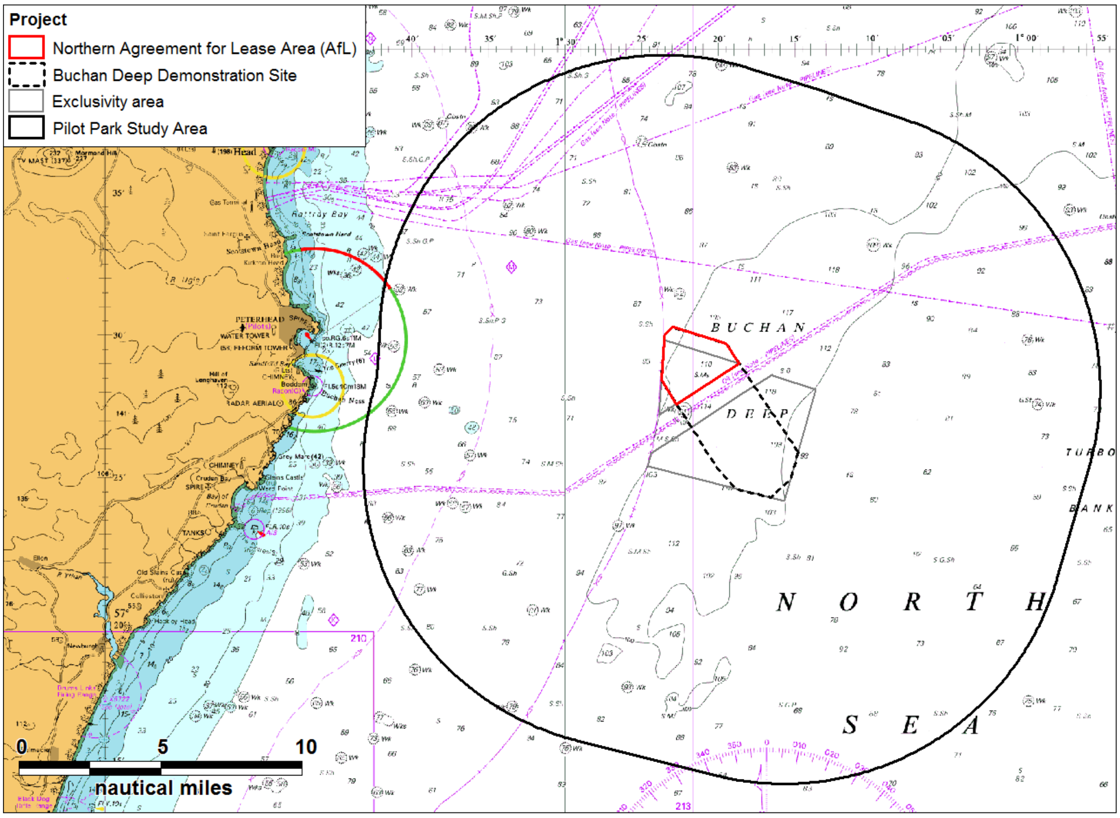


Figure 4.1 General Overview of Hywind Scotland Pilot Park Project

AIS is required on board all vessels of more than 300 gross registered tonnage (GRT) engaged on international voyages, cargo vessels of more than 500 GRT not engaged on international voyages, passenger vessels irrespective of size built on or after 1st July 2002, and fishing vessels over 18m in length (at the time of the surveys). A proportion of smaller vessels also carry AIS voluntarily but may not broadcast continuously.

The AIS was the main data set used for recreational vessels as well as assisting in the analysis of smaller vessels (fishing and recreation).

4.4 Recreational Activity

The RYA and the CA represent the interests of recreational users including yachting and motor cruising. In 2005 the RYA, supported by Trinity House Lighthouse Service (THLS) and the CA, compiled and presented a comprehensive set of charts which defined the cruising routes, general sailing and racing areas used by recreational craft around the UK coast. This information was published as the UK Coastal Atlas of Recreational Boating and has been subsequently updated (RYA, 2009). The latest edition of GIS shapefiles from 2010 showing cruising routes, sailing and racing areas has been used in this assessment.

The RYA has also developed a detailed position statement (RYA, 2013) based on analysed data for common recreational craft; this, along with extensive consultation, were used to inform the NRA.

In addition, recreational vessel data were extracted from the AIS tracks recorded during the 16 week survey period in 2013 and 2014 data.

4.5 Fishing Activity

Fishing vessel data were extracted from the AIS data recorded during the 16 week shipping surveys in 2013 and 2014.

In addition, longer term data on fishing vessel sightings were received from Marine Scotland Compliance, and satellite monitoring data were obtained from the MMO. These were used to validate the survey data presented in the baseline assessment.

Sightings data were analysed from the 2008-2012 period. These data have been collected through the deployment of patrol vessels, surveillance aircraft and the sea fisheries inspectorate. Each patrol logs the position and details of fishing vessels within the area being patrolled. All vessels are logged, irrespective of size, provided they can be identified by their Port Letter Number (PLN).

Satellites record the positions of fishing vessels of 15m length and over a minimum of every two hours. Data have been analysed from the 2011-2012 period, with additional analysis of 2008-2011 data

Fishing vessels were also identified during the ESAS bird survey work when visual observations were recorded by surveyors onboard the *Eileen May* survey vessel, and also during the vessel logging onboard the *Franklin* geophysical survey vessel.

4.6 Lessons Learned

There is considerable benefit in the sharing of lessons learned to developers within the offshore industry. This NRA, and in particular the hazard assessment, includes general consideration for lessons learnt and expert opinion from previous offshore wind farm developments and other sea users. Lessons learnt data sources and expert opinion include:

- RYA & Cruising Association (CA). Sharing the Wind - Identification of recreational boating interests in the Thames Estuary, Greater Wash and North West (Liverpool Bay). Southampton (RYA, 2004);
- DfT. Results of the electromagnetic investigations. 2nd ed. Southampton: MCA and QinetiQ (DfT, 2004);
- BWEA. Guidelines for Health & Safety in the Wind Energy Industry – British Wind Energy Association. London: (BWEA (now RUK), 2008);
- MCA. Offshore Wind Farm Helicopter Search and Rescue – Trials Undertaken at the North Hoyle Wind Farm Report of helicopter SAR trials undertaken with Royal Air Force Valley 'C' Flight 22 Squadron on March 22nd 2005. Southampton: (MCA, 2005);
- The Nautical and Offshore Renewable Energy Liaison (NOREL). (Unknown). A Report compiled by the Port of London Authority based on experience of the Kentish Flats Wind Farm Development. Norel Work Paper, WP4 (2nd NOREL); and
- TCE. Strategic assessment of impacts on navigation of shipping and related effects on other marine activities arising from the development of Offshore Wind Farms in the UK REZ. TCE and Anatec (TCE, 2012).
- G9 Offshore Wind Health and Safety Association. Incidents Data (G9, 2013)

6. PROJECT DESCRIPTION DETAILS

The scope of this NRA reflects a Rochdale (Design) Envelope defined by HSL to address elements of uncertainty associated with the ongoing design of the Project. The following section details the worst realistic case parameters of the Project against which the shipping and navigation effects will be assessed.

6.1 Introduction

The Hywind Scotland Pilot Park Project will consist of five, 6 megawatt (MW) floating Wind Turbine Generator (WTG) Units with a total capacity of up to 30MW. The WTG Units will be attached to the seabed by a three-point mooring spread and will be connected by inter-array cables. The export cable is planned to come ashore at Peterhead.

6.2 Location Overview

HSL has been awarded an Agreement for Lease (AfL) from TCE for the deployment of floating turbines in an area of deep water (95m-120m) within the Buchan Deep, offshore from Peterhead in the north east of Scotland, just beyond the 12nm territorial limit.

The Buchan Deep Demonstration Site, Northern Agreement for Lease (AfL) Area, and proposed cable route corridor are presented in Figure 6.1, with a detailed view presented in Figure 6.2.

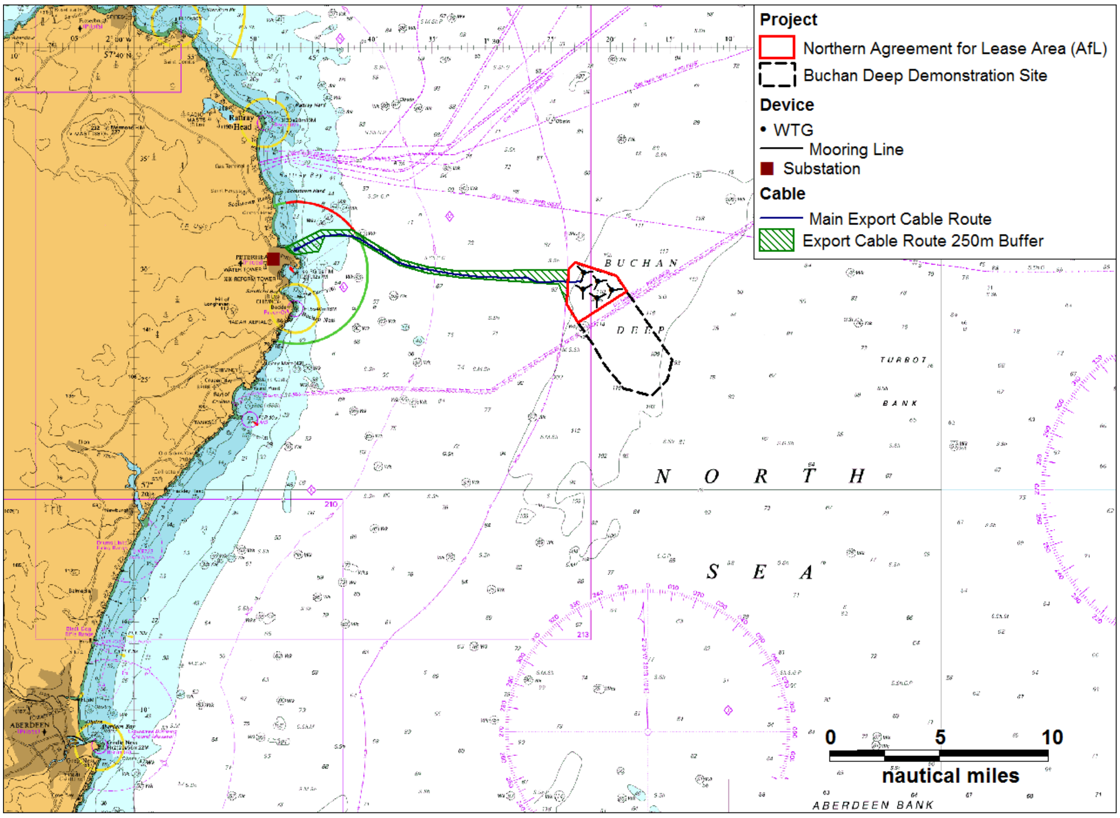


Figure 6.1 General Overview of Hywind Scotland Pilot Park Project

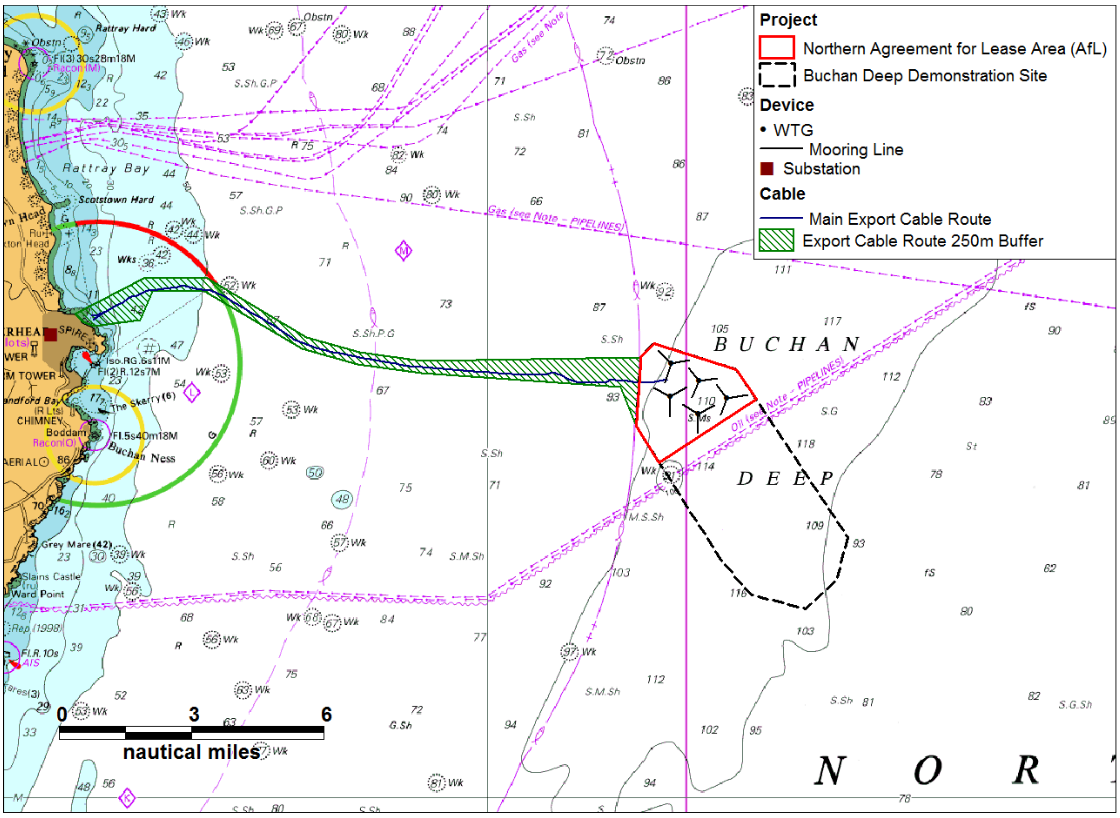


Figure 6.2 Detailed Overview of Hywind Scotland Pilot Park Project

The total area of the Buchan Deep Demonstration Site is 15.6nm^2. The Buchan Deep Demonstration Site is split into northern and southern sections by the Forties Pipeline System passing through the Site. The base case for the offshore Project element is for the WTG Units to be installed within the Northern AfL area, which has a total area of 4.5nm^2. The export cable corridor follows a route that runs east west from the northwest edge of the Northern AfL area to the landfall area of search which extends north along the coast of Peterhead from Peterhead Harbour to Buchanhaven Harbour.

The corner coordinates, in degrees decimal minutes, of the Northern AfL area are presented in Table 6.1, with Figure 6.3 displaying the corresponding corners of the Northern AfL area.

Table 6.1 Northern AfL Area Corner Coordinates (World Geodetic System (WGS) 84 Universal Transverse Mercator (UTM) Zone 30N)

Point	Latitude	Longitude
A	57° 30.3017' N	001° 23.0331' W
B	57° 29.7151' N	001° 19.5416' W
C	57° 29.0226' N	001° 18.6905' W
D	57° 27.6029' N	001° 22.7969' W
E	57° 28.4165' N	001° 23.7620' W
F	57° 29.9892' N	001° 23.5731' W

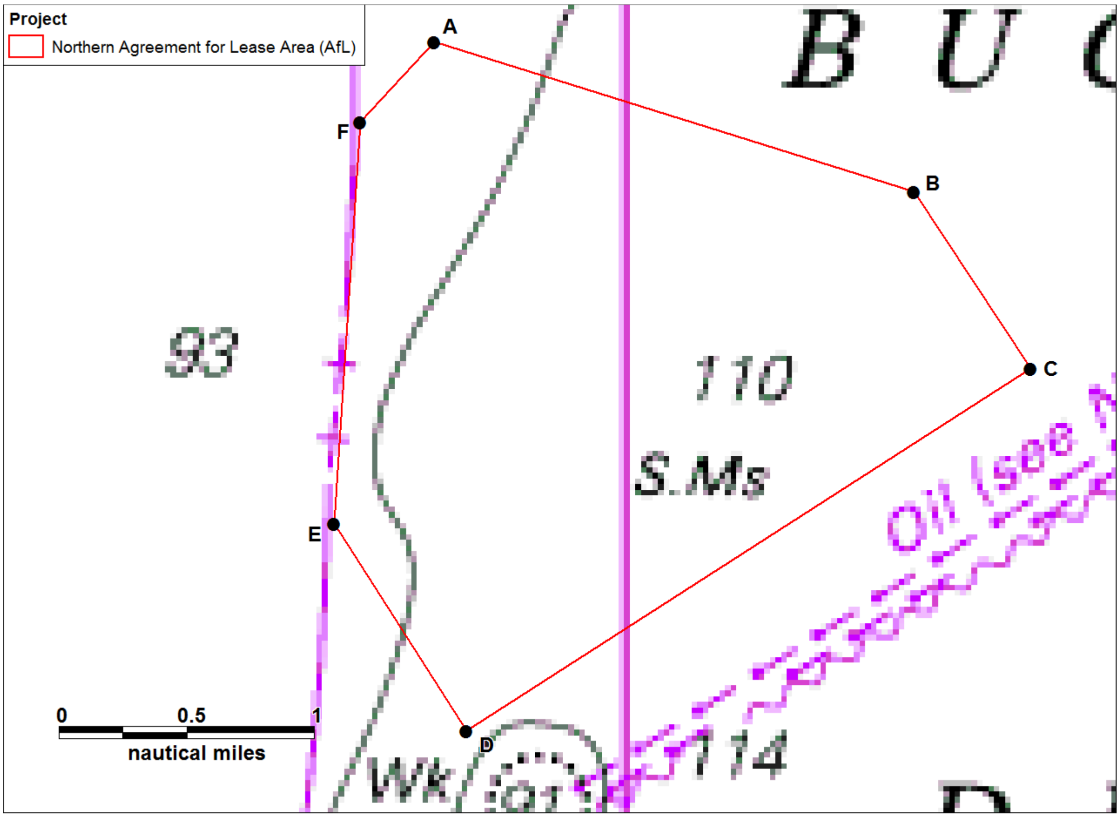


Figure 6.3 Corner Coordinates of Northern AfL Area of the Project

6.3 Hywind Scotland Pilot Park Project Offshore Components

6.3.1 WTG Units

Hywind Scotland WTG Units will consist of a steel tower and substructure filled with ballast water and solid ballast, based on the Hywind Demo slender buoy (SPAR[1]) concept. Figure 6.4 presents an illustration of the Hywind Scotland WTG Unit.

[1] A tall, vertically floating, slender cylindrical buoy with a large draught.

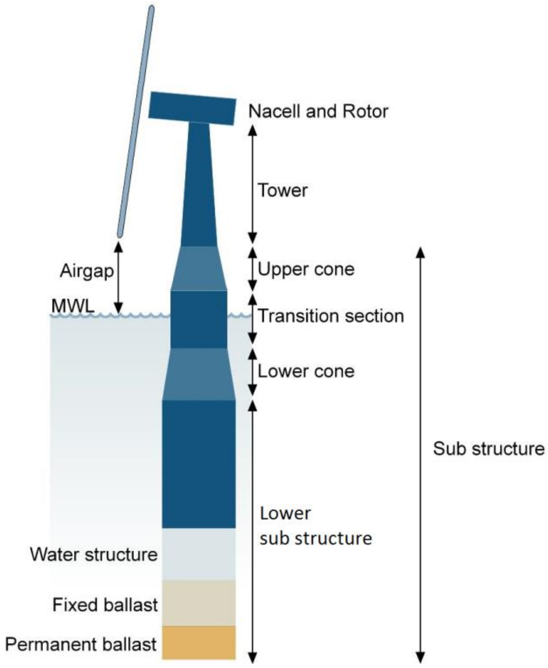


Figure 6.4 Illustration of Hywind Scotland WTG Unit (not to scale)

6.3.2 Design Specifications

Design specifications for the Hywind Scotland WTG Unit and associated mooring lines, which provide the basis of the design envelope for the purpose of the NRA, are summarised in Table 6.2.

Table 6.2 WTG Unit and Mooring Line dimensions assumed in Navigation Assessment

Element	Design Specifications
Substructure diameter	15m
Operating water depths	95m-120m
Air gap	Minimum 22m
Spacing between WTG Units	800m-1,600m
Mooring lines – radius from centre	600m-1,200m

The exact size of the Hywind Scotland Pilot Park Project will depend on the spacing between the WTG Units and location of the anchors and mooring lines. It is anticipated that the total area of seabed that the Hywind Scotland Pilot Park Project will occupy (including the mooring system) will be no more than 5.1nm^2 (17.5km^2) and will be within the Northern AfL area. The WTG Units occupy a footprint area of approximately 1.2nm^2-1.5nm^2 (4km^2-5km^2). The anchor mooring spread would be contained within the Northern AfL area and occupy an area of approximately 4.5nm^2 (15km^2).

The WTG Units will have a minimum rotor blade tip clearance (air draught) over the water level in accordance with RYA and MCA recommendations (22m above Mean High Water Springs (MHWS)) (RYA, 2013) (MCA, 2008a).

6.3.3 Anchors

The five WTG Units will be located between 800m-1600m apart and will be attached to the seabed by a three-point mooring spread, an indicative turbine layout and associated anchor spread is presented in Figure 6.5. Each WTG Unit will have three anchors, with the possibility of some anchors being shared between Units. There will be a maximum of 15 anchors for the Hywind Scotland Pilot Park Project.

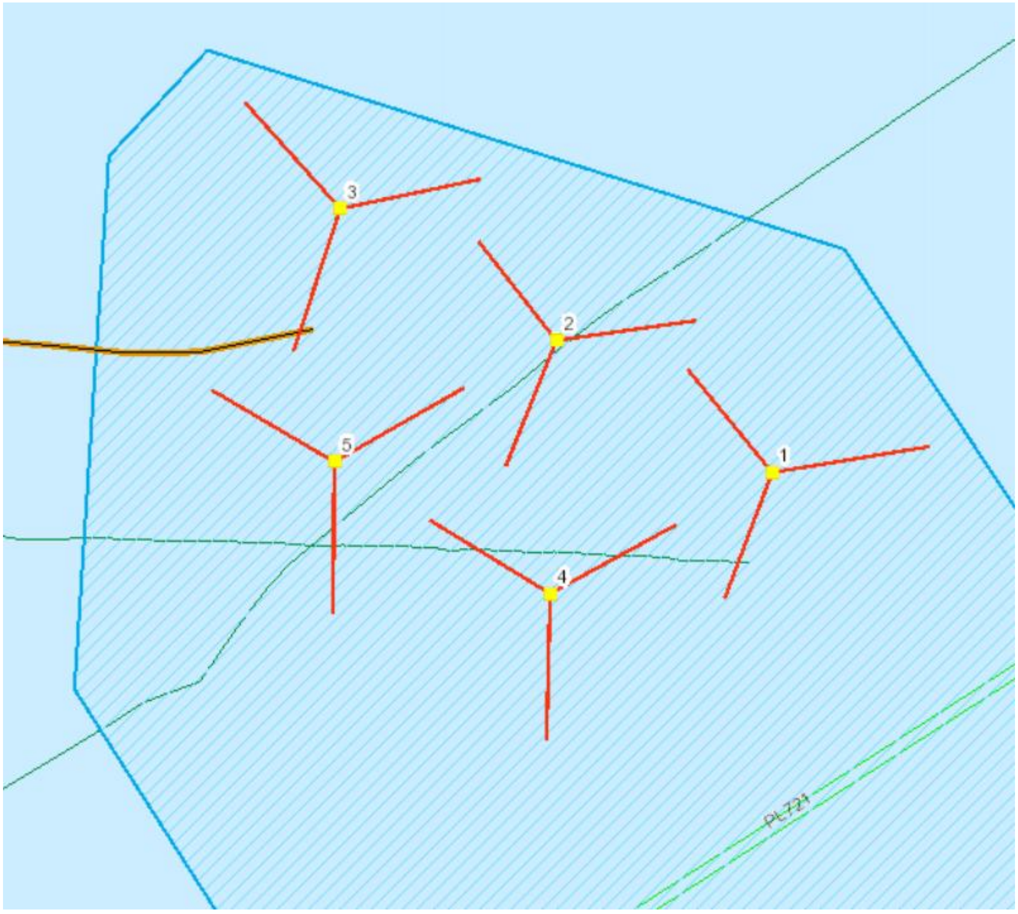


Figure 6.5 Hywind Scotland Pilot Park Project Indicative WTG Unit Layout

WTG Units will be secured to the seabed using suction anchors, which are likely to have a diameter of $7m^2$, which corresponds to an estimated footprint of $40m^2$ per anchor. Scour protection (e.g. rock dumping, mattresses) will be required around the anchors and is expected to extend 15m from the anchor perimeter, giving a footprint area of $900m^2$-$1,000m^2$ for each anchor, and a total footprint of $15km^2$ for all 15 anchors.

6.3.4 Mooring Lines

Mooring lines are likely to consist of offshore grade mooring chains of 100mm-140mm diameter. Concrete-block or ballasted steel-frame clump weights may need to be attached to the chains as part of the mooring arrangement. The clump weight will not touch the seabed during normal operation. The mooring radius per WTG Unit will be between 600m-1,200m.

6.3.5 Inter-array Cables

The WTG Units will be connected by inter-array electric cables. The cables could be attached to the WTG Units either above or below the waterline. The section of inter-array cable running between each WTG Unit will lie on / or be buried within the seabed. It is possible that the cables will be arranged in a ring circuit configuration where an inter-array cable will connect the first WTG Unit to the last WTG Unit, as presented in Figure 6.6.

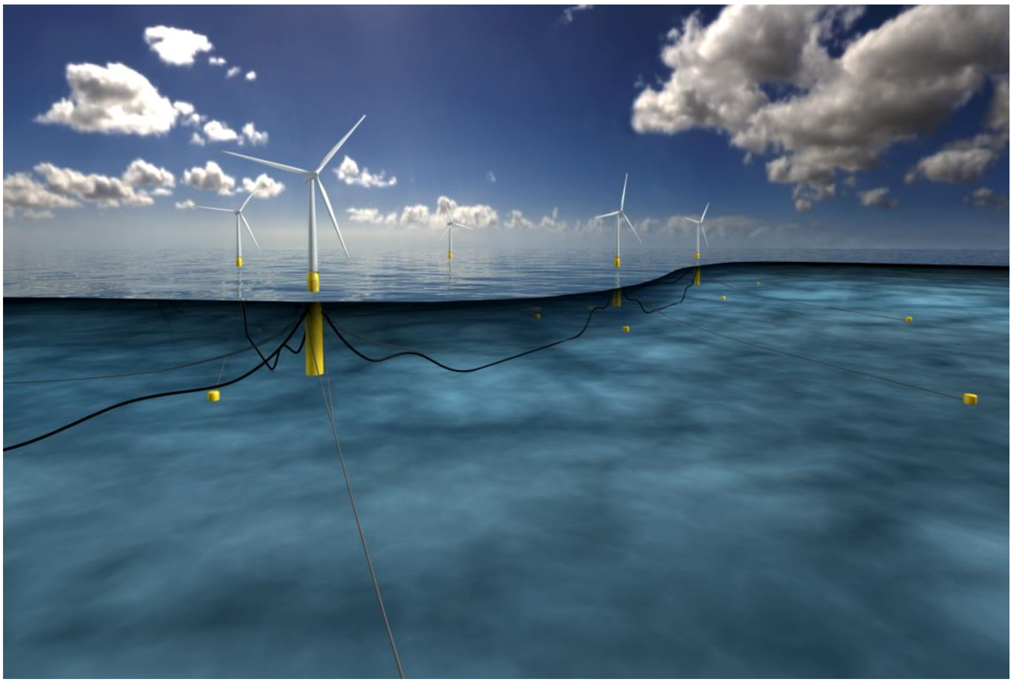


Figure 6.6 Inter-array and Export Electric Cables

There will be a maximum of five inter-array cables each of which will have a maximum length of 3km. The inter-array cables may need to use buoyancy elements and / or anchors to maintain location and configuration.

Figure 6.7 illustrates the dynamic subsection of the subsea cable and how it is suspended in water, displaying how the cable is laid in an ‘s-shape’, thus allowing the floating structure to move without stretching or snapping the cable. A small anchor is likely to be used to stabilise the cable, then there is a section of cable where it is expected that buoyancy elements and bend stiffeners are installed. The cable is then connected to the floating WTG Unit via a J-tube on the outside of the substructure.

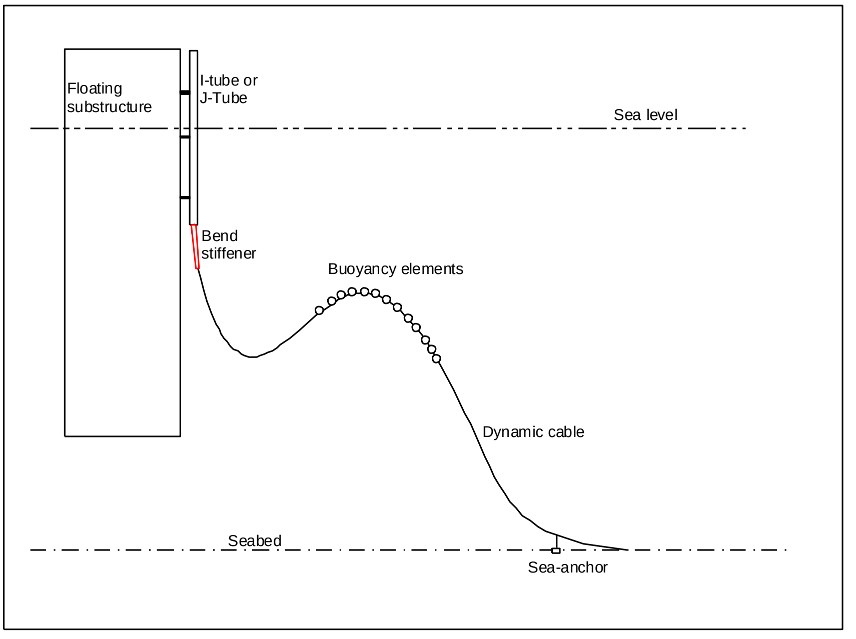


Figure 6.7 Attachment of Inter-Array Cable to WTG Unit via a J-Tube

Inter-array cables will have a transfer voltage of either 33 Kilovolts (kV) or 66kV, with electricity transmitted as Alternating Current (AC) at 50 hertz (Hz). Cables will be armoured, with an expected diameter of 0.15-0.3m.

6.3.6 Export Cable and Cable Route Corridor

The export cable will be AC transmission with a transfer voltage of either 33kV or 66kV. The export cable will be armoured, with an expected diameter of 0.15m-0.3m. The dynamic end of the export cable is expected to be terminated on a floating WTG Unit.

The export cable will run from the Hywind Scotland Pilot Park Project to a landfall located along the coast at Peterhead. The cable route will be located within the cable corridor presented in Figure 6.1. The export cable will be 25km-35km long, depending on the location of the WTG Units, mooring configuration and arrangement of the inter-array cables.

The export cable will be buried within a trench, which will be approximately 6m wide and up to 2m in depth. It may not be possible to bury the full length of the cable to the desired depth, therefore rock dumping, mattresses or sand / grout bags may be required to protect the cable.

6.4 Construction Phase

6.4.1 Hywind Scotland Pilot Park Project Mooring System Installation

It is likely that the seabed mooring system consisting of suction anchors will be pre-installed prior to inter-array cable installation and towing to the site of the preassembled WTG Units.

The method expected to be used for pre-installation of suction anchors would be for the anchors to be lowered from an anchor handling vessel or a light subsea construction vessel onto the seabed, using a crane, A-frame, or similar lifting device. A remotely operated underwater vehicle (ROV) would be deployed to monitor touchdown on the seabed. Once touchdown is complete, suction pumps will be activated to create a minor vacuum within the anchors to force the anchors into their installed position. Once the anchors are installed the lower mooring system comprising between 150m-600 m of mooring line will be lowered to the seabed with a retrieval system.

For installation purposes, the retrieval system will most likely be either a buoy floating on the surface, a buoy restricted to floating approximately 10m above the seabed for pick-up by ROV, or a pennant wire that can be retrieved using a grapple.

Given that the anchors and pre-installed lower mooring lines will most likely be fully submerged, a Notice to Mariners will be issued to inform mariners of the location of the anchors and mooring lines on the seabed.

6.4.2 Additional Project Components for WTG Unit Assembly

In addition to the components detailed above, the Hywind Scotland Pilot Park Project will use a deep water inshore area, the location of which is still to be determined, to assemble the WTG Units prior to installation. Once assembled, the WTG Units will be towed in an upright position from the assembly area to the Buchan Deep location.

The design envelope does not include the inshore assembly site, floating storage, onshore stage site or tow route and will not be assessed in detail during this stage of the NRA. There will be additional impacts associated with towing the WTG Units from the inshore assembly area to the Pilot Park Project. Once the location of the assembly site is known, there will be a risk assessment undertaken as mitigation for this phase of the Project.

These additional Project components and activities are subject to separate Marine Licences and other permits and will therefore not be included in the Marine Licence application for the Pilot Park Project.

7. EXISTING ENVIRONMENT

7.1 Introduction

This section presents the existing environment baseline information relating to navigation in the vicinity of the Hywind Scotland Pilot Park Project.

The Northern AfL area and Buchan Deep Demonstration Site are located mainly within Buchan Deep, which is an area of deep water (95m-120m) situated approximately 12nm east of Buchan Ness, near Peterhead, on the northeast coast of Scotland.

The following baseline features in the vicinity of the Northern AfL area are reviewed:

- Ports and Harbour Limits
- Navigational Aids
- Anchorage Areas
- IMO Routeing Measures
- Wrecks
- Oil and Gas Infrastructure
- Offshore Wind
- Dredging
- Cables and Pipelines
- Exercise Areas
- MEHRAs
- Other Existing Environmental Features
- Sailing Directions

7.2 Navigational Features

The principal navigational features relative to the Northern AfL area are presented in Figure 7.1. This figure displays the Harbour Limits of Peterhead and Aberdeen ports, navigational aids and anchorage areas. The light and buoy positions are taken from Admiralty Charts of the area.

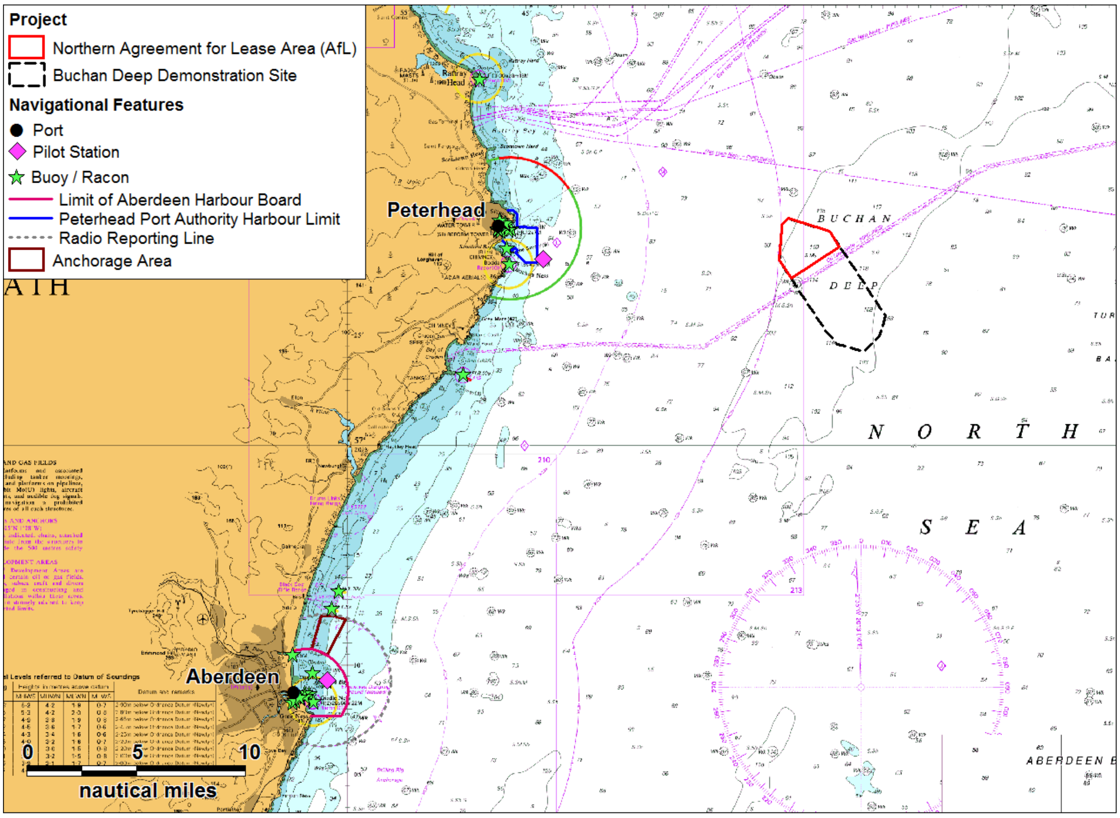


Figure 7.1 Navigational Features in the vicinity of the Northern AfL Area

7.2.1 Peterhead

The nearest port is located at Peterhead, with the Harbour Limits approximately 11nm to the west of the Northern AfL area. Peterhead is a major supply base for the offshore oil and gas industry and the most important fishing port in the UK for white and pelagic species. The port also handles tankers, general cargo ships and cruise liners, and has a marina for pleasure craft. The Oil jetty can handle vessels up to 250m length and 10.5m draught. A detailed chart of Peterhead Harbour is presented in Figure 7.2.

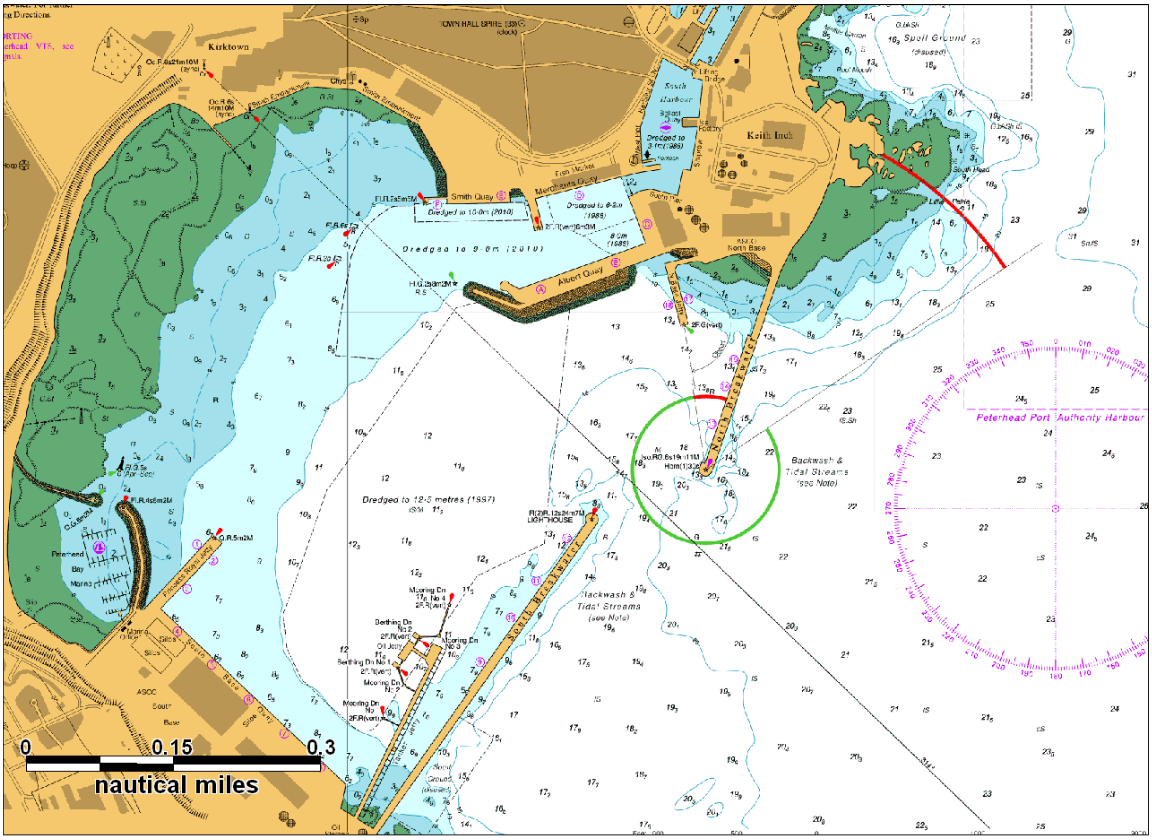


Figure 7.2 Detailed Chart of Peterhead Port

The entrance to Peterhead Bay faces SE and is 208m wide between the breakwaters. Within the entrance there is a tanker jetty in the lee of South Breakwater. Peterhead Bay offers an anchorage in depths exceeding 11m. The best holding ground is under the lee of the South Breakwater consisting of fine sand over blue clay or mud with occasional boulders. Admiralty Sailing Directions note that in bad weather, vessels anchored in Peterhead Bay (within the breakwaters) have been known to drag anchor. While at anchor vessels must maintain a good lookout and a continuous VHF radio watch. Engines are to be held ready for immediate use.

Pilotage is compulsory within Peterhead Harbour for all vessels exceeding 3500 GRT, laden oil tankers, vessels carrying hazardous cargoes or dangerous goods in bulk or quantities of 100 tonnes or more, and vessels carrying more than one tonne of IMO Class 1 explosives.

A Vessel Traffic Service (VTS) with AIS and radar surveillance is maintained for the advice of shipping.

7.2.2 Aberdeen

Aberdeen Port is located to the southwest, with the Harbour Limits 27nm from the Northern AfL area. It is the principal commercial port serving the northeast of Scotland with approximately 7,800 ship arrivals in 2013 handling approximately 4.9 million tonnes of cargo.

The Port is the most important base for the North Sea oil and gas industry in northwest Europe. In addition there are regular shipping services to Orkney, Shetland and Scandinavia via Ro-Ro services for passengers and cargo. The Port also has a large fish market.

Pilotage is compulsory for all vessels navigating in the Aberdeen Pilotage District except for vessels under 60m in length, vessels between 60m-75m in length and fitted with an operational bow thruster unit, and vessels moving within the harbour from berth to berth with permission of the Harbour Master.

There is a designated anchorage area to the north of the Aberdeen Harbour limits, which was established in 2010.

7.3 IMO Routeing Measures

There are no IMO Routeing Measures (e.g. TSSs or Recommended Routes) in the vicinity of the Northern AfL area.

7.4 Wrecks

The wrecks in the vicinity of the Northern AfL area are presented in Figure 7.3. The positions of these have been taken from the most detailed Admiralty Charts of the area. It should be noted that Admiralty Charts contain only wrecks which are considered to be a navigational hazard, so there may be other, uncharted, wrecks in the vicinity.

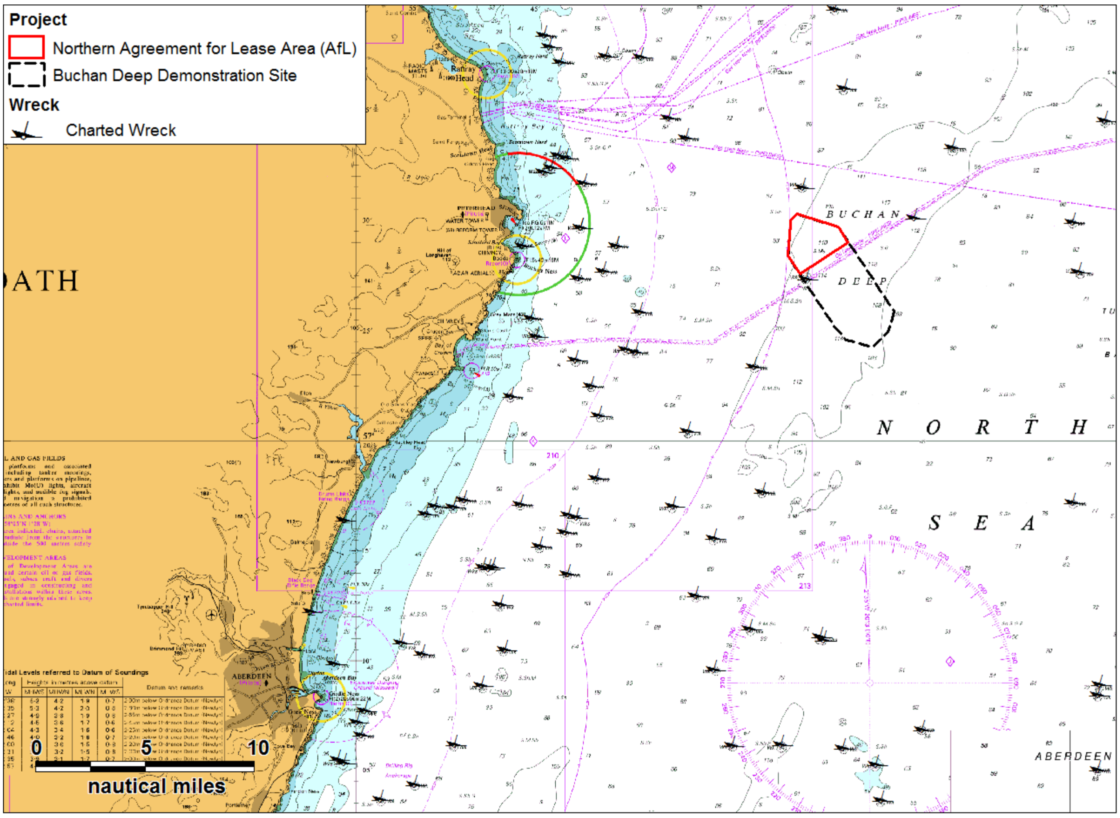


Figure 7.3 Wrecks in the vicinity of the Northern AfL Area

There are no charted wrecks within the Northern AfL area. There is one wreck to the south of the Northern AfL area, within the Buchan Deep Demonstration Site. This wreck is submerged to 91m depth.

7.5 Oil and Gas Infrastructure

The oil and gas installations, licence blocks and pipelines in the vicinity of the Northern AfL area are presented in Figure 7.4.

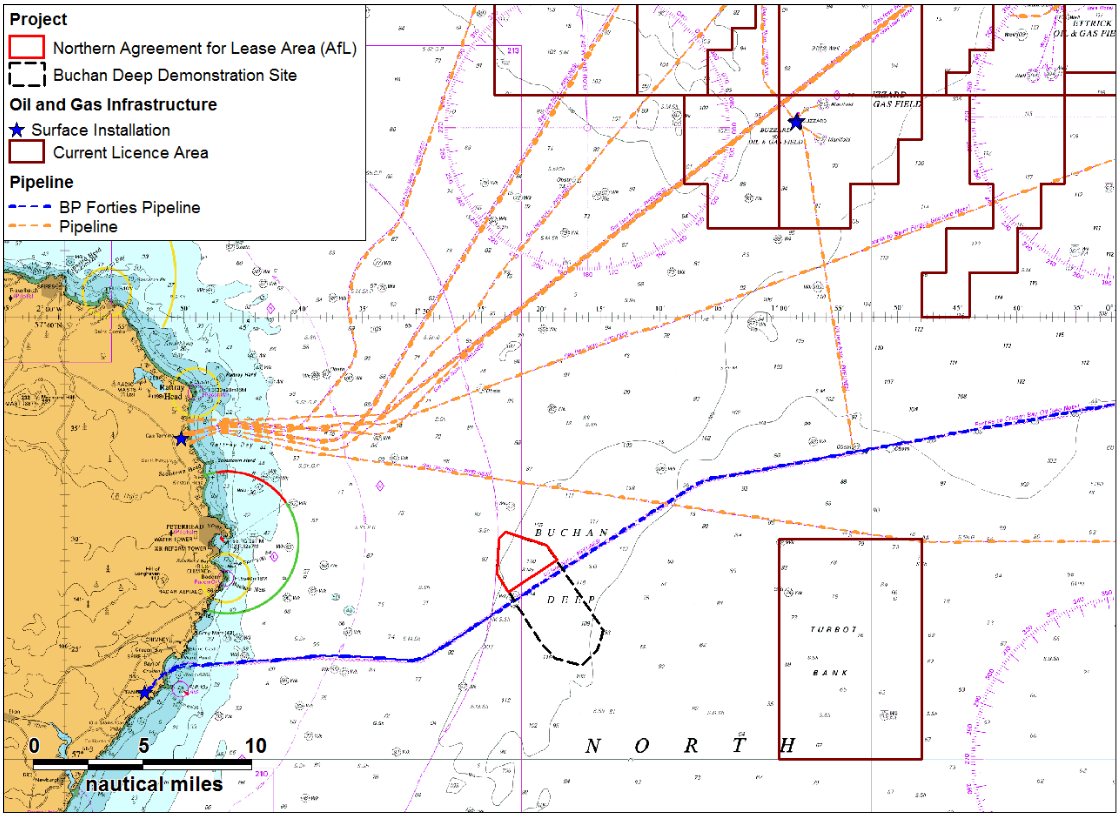


Figure 7.4 Oil and Gas Installations and Licence Areas in the vicinity of the Northern AfL Area

Licence Block 20/16 lies 10nm east of the Northern AfL area. It is licenced to Sendero Petroleum Limited.

The closest offshore installation is within the Buzzard Oil and Gas Field operated by Nexen Petroleum at a distance of 22.3nm northeast of the Northern AfL area.

The BP Forties Pipeline System crosses the Buchan Deep Demonstration Site running northeast to southwest between the Forties Oil Field and Port Errol at Cruden Bay. A minimum 500m buffer will be in place between the pipeline and the nearest turbine to provide room for access should there be a need for future access by a vessel for maintenance, etc.

7.6 Offshore Wind

Existing and planned offshore wind farm projects in the vicinity of the Northern AfL area are presented in Figure 7.5.

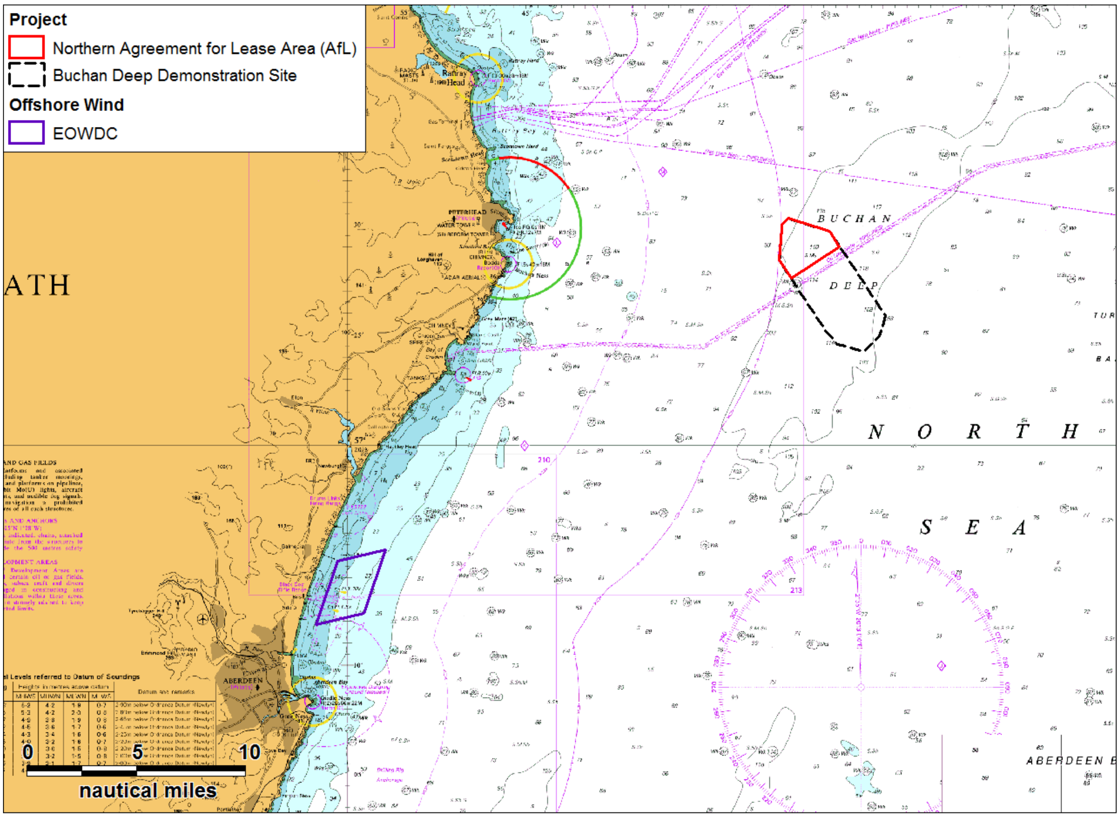


Figure 7.5 Wind Farm Areas in the vicinity of the Northern AfL Area

The AfL area for the proposed European Offshore Wind Deployment Centre (EOWDC), situated in Aberdeen Bay, is located approximately 22.2nm southwest of the Northern AfL Area. The total area of the EOWDC AfL area is approximately 5.8nm^2 (20 km^2). It is planned to consist of 11 turbines with an installed capacity of up to 100MW.

It is currently being developed by Aberdeen Offshore Wind Farm Limited (AOWFL), a joint venture between Vattenfall and Aberdeen Renewable Energy Group (AREG), plus partner Technip. The consent application for the EOWDC has been granted approval and construction is planned to commence in 2015.

7.7 Dredging

There are no aggregates dredging areas in the vicinity of the Northern AfL area. No BMAPA dredger routes transit in the vicinity of the Northern AfL area.

7.8 Cables and Pipelines

Subsea cables and pipelines in the region of the Northern AfL area are presented in Figure 7.6.

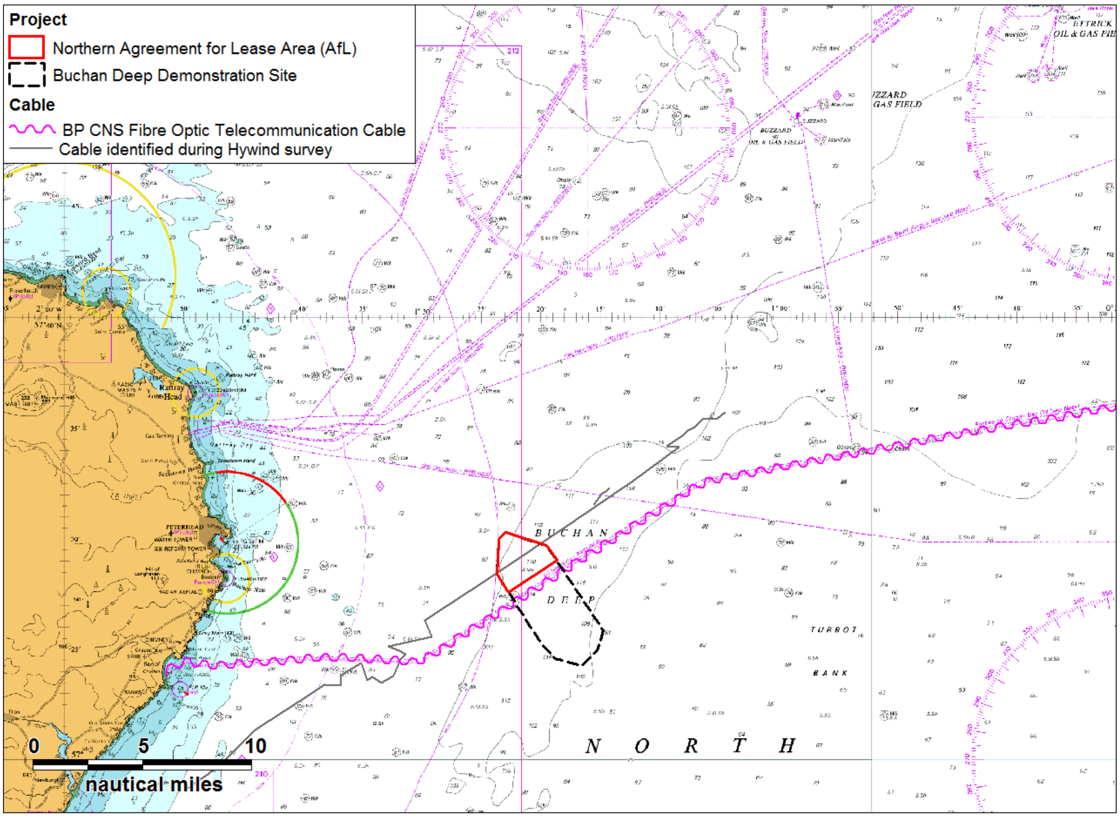


Figure 7.6 Cables and Pipelines in the vicinity of the Northern AfL Area

The BP CNS Fibre Optic Telecommunications Cable crosses the Buchan Deep Demonstration Site running northeast to southwest, running the length of the BP Forties Pipeline System.

An inactive BT cable, identified during Hywind cable surveys, crosses the Northern AfL area, spanning from Aberdeen to Bergen. An unknown cable was identified during the Hywind survey, which is present 2.8nm northeast of the Northern AfL area.

Mariners are advised not to anchor or trawl in the vicinity of submarine cables and pipelines, and thatpipelines are not always buried.

7.9 Exercise Areas

Figure 7.7 presents the military practice areas in use by the Ministry of Defence (MoD) in the locality of the Northern AfL area.

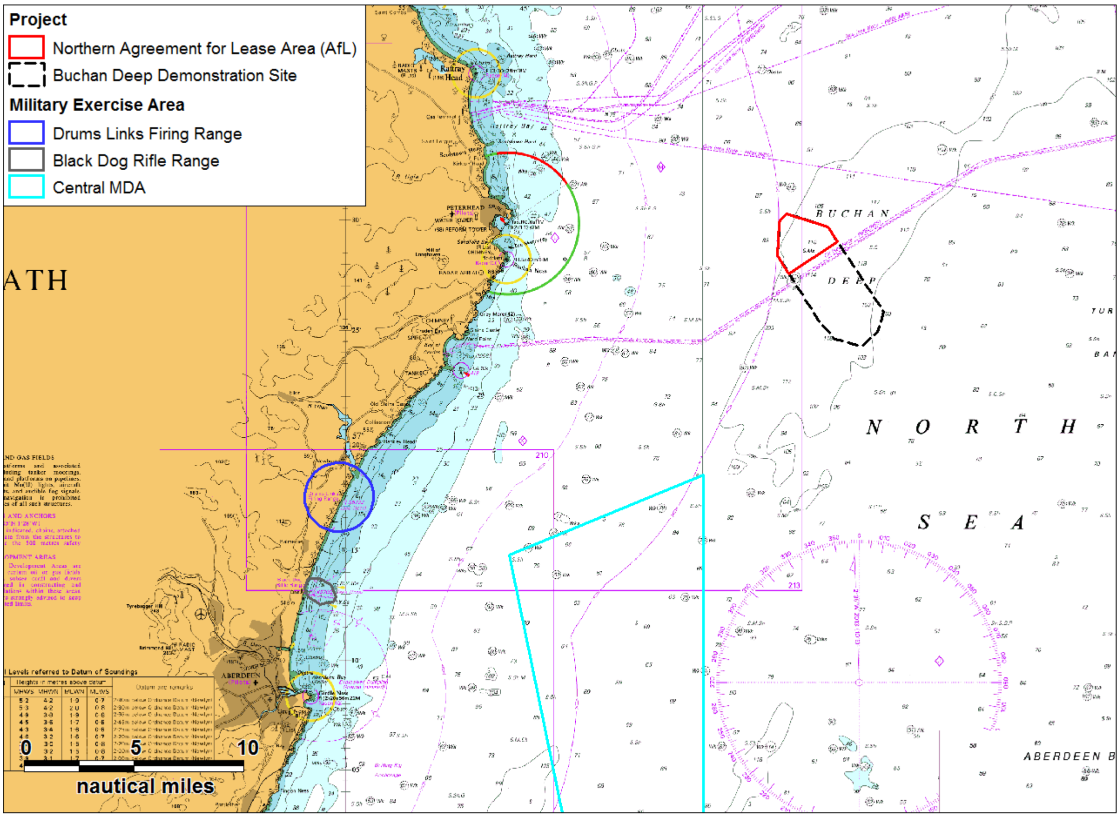


Figure 7.7 Military Practice Areas in the vicinity of the Northern AfL Area

The Drums Links firing range, 21.2nm southwest of the Northern AfL area, and Black Dog rifle range, 25.2nm southwest of the AfL area, are located along the coast near to Aberdeen. No restrictions are placed on the right to transit the firing practice areas at any time. The firing practice areas are operated using a clear range procedure. Exercises and firing only take place when the areas are considered to be clear of all shipping. Red flags and occasionally red lights are displayed from flagstaffs on the shore when firing takes place.

A Managed Defence Area (MDA) used by the RAF is 9.9nm to the southwest of the Northern AfL area at its nearest point.

7.10 Marine Environmental High Risk Areas

Figure 7.8 presents the location of Newburgh and Kinnaird Head MEHRAs.

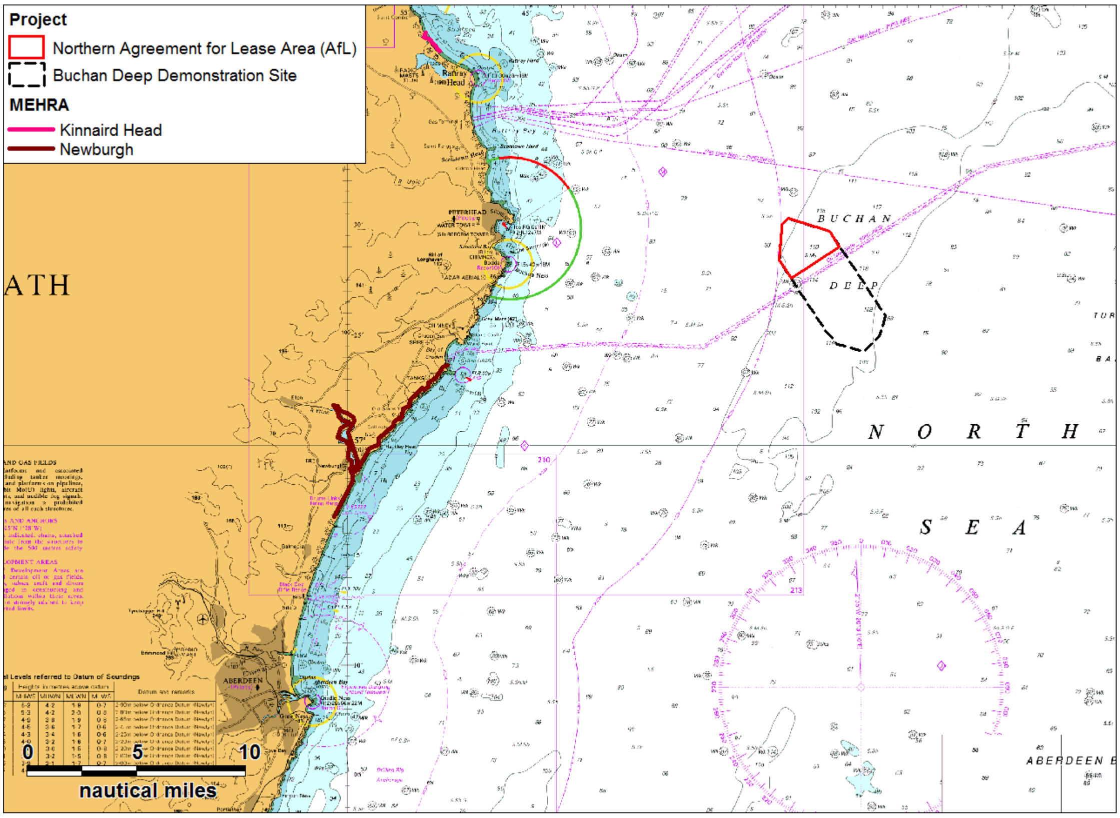


Figure 7.8 MEHRAS in the vicinity of the Northern AfL Area

Newburgh MEHRA, located approximately 16nm southwest of the Northern AfL area, has underlying statutory designations on wildlife, landscape and geological grounds. There is a high concentration of vulnerable seabirds and a range of fishing activities. The MEHRA lies between Aberdeen and Peterhead and traffic to and from both ports passes by.

Kinnaird Head MEHRA, located approximately 17nm northwest of the Northern AfL area, has underlying statutory designations on wildlife, landscape and geological grounds. There is a very high concentration of vulnerable seabirds and a range of fishing and amenity / economic activity.

7.11 Other Navigational Features

Figure 7.9 presents other navigational features within the vicinity of the Northern AfL area.

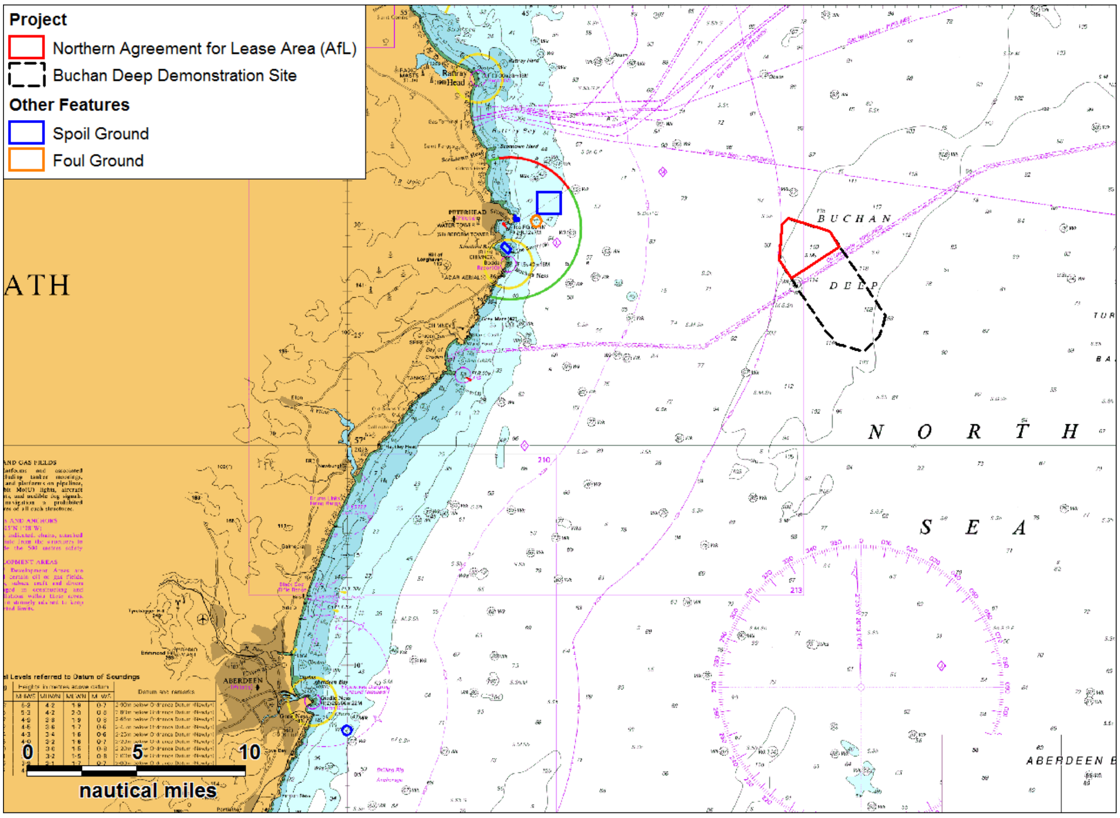


Figure 7.9 Other Navigational Features in the vicinity of the Northern AfL Area

An area of spoil ground lies to the southwest, 28.6nm from the Northern AfL area. Three areas of spoil ground are located west of the Northern AfL area, in the vicinity of Peterhead Bay, the closest 10nm away. An area of foul ground lies in the vicinity of Peterhead Bay.

7.12 Sailing Directions

Admiralty Sailing Directions for the area are presented in the North Sea (West) Pilot (UKHO, 2009). A plot of the routes for vessels in the vicinity of the Northern AfL area is presented in Figure 7.10.

Figure 7.10 Routes in the vicinity of the Northern AfL Area (UKHO, 2009)

The arrows are not precise if superimposed on a chart but they illustrate the general passages used by vessels. A description of the routes nearest the Northern AfL area is given below.

7.12.1 Rattray Head to Buchan Ness (Arrow 3.5)

From Rattray Head, the route leads south for a distance of 9nm to a position east of Buchan Ness, crossing the approaches to Peterhead 2nm north of Buchan Ness.

7.12.2 Buchan Ness to Aberdeen (Arrow 3.43)

From a position east of Buchan Ness the route leads south-southwest for a distance of 22nm to Fairway Light Buoy 1nm northeast of the entrance to Aberdeen Harbour.

8. METOCEAN DATA

8.1 Introduction

This section presents metocean statistics for the area which have been used as input to the risk assessment.

According to the Admiralty Sailing Directions (UKHO, 2009), the climate of the east coast of Scotland is generally mild for the latitude with winds most usually from between south and northwest. In winter, strong to gale force winds, cloudy to overcast skies and rain / snow are common, although precipitation amounts are not large. On occasion easterly winds can bring exceptionally cold weather to the region. In summer, gales become less frequent than in winter although winds are often fresh or strong. There is little seasonal variation in the rainfall and the summer months are often cloudy and cool.

Fog (or haar) occasionally affects the east coast, particularly in the north. Over the open sea, fog is not especially frequent.

8.2 Wind

The wind data for the site has been taken from recordings at Buchan Deep (57.40°N, 01.28°W), for the period 1958-2010 (Statoil, 2014a).

The wind rose for one hour average wind speed 10m above sea level is displayed in Figure 8.1.

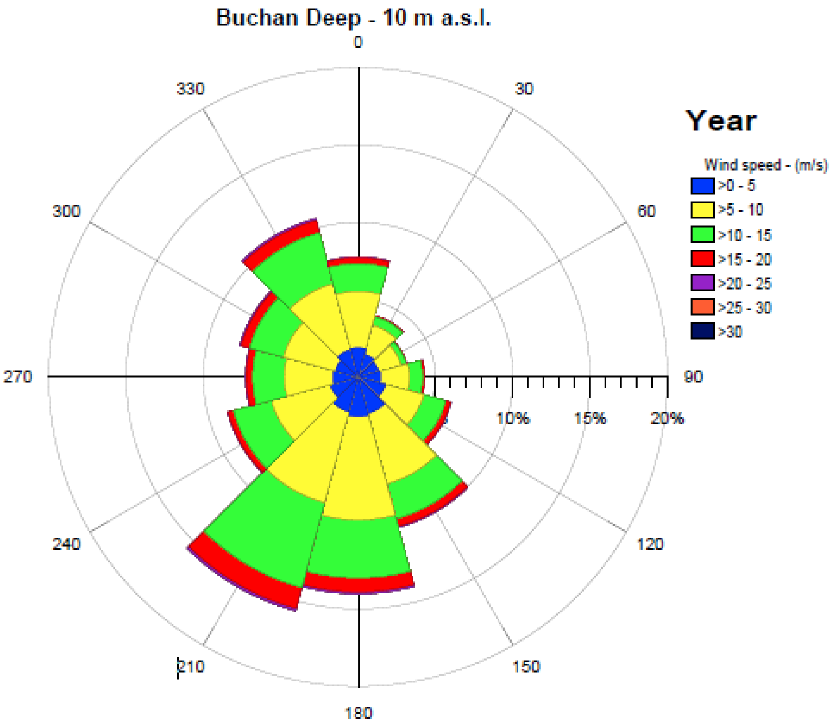


Figure 8.1 Wind Rose for 1 hour average Wind Speed 10m above Sea Level (1958-2010)

The average wind speed was 8.5 m/s (approximately 16 knots) with the predominant direction being north-west.

8.3 Wave

The wave data for the site has been taken from recordings at Buchan Deep (57.40°N, 01.28°W), for the period 1958-2010 (Statoil, 2014). The all-year wave rose is presented in Figure 8.2.

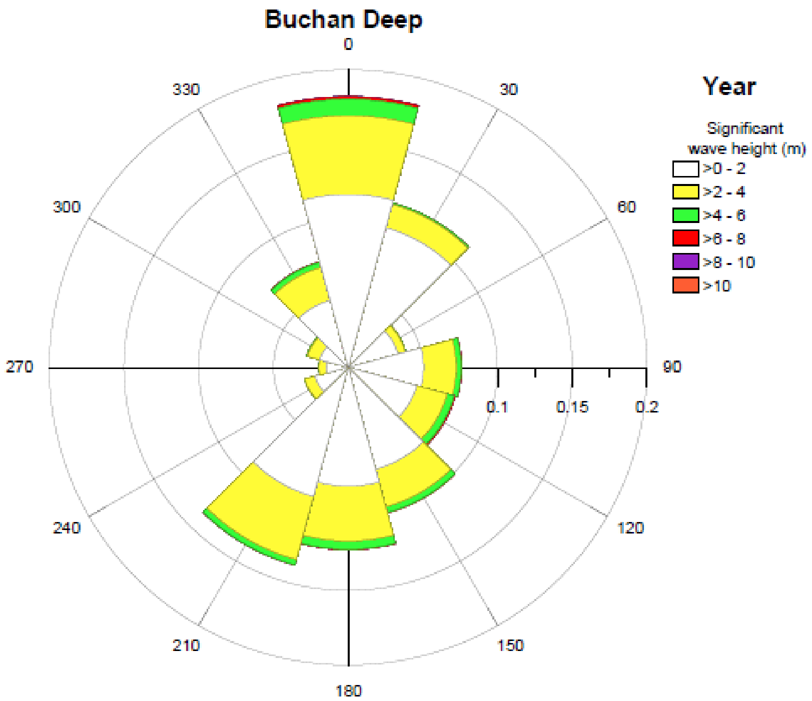


Figure 8.2 All Year Wave Rose for Buchan Deep (1958-2010)

The mean significant wave height at Buchan Deep is 1.8m. The predominant wave direction is north.

8.4 Visibility

Historically, visibility has been shown to have a major influence on the risk of ship collision. According to the Admiralty Sailing Directions (UKHO, 2009), sea fog (visibility less than 1km) is not especially common over the open sea, but good visibility in excess of 10 miles is also rather infrequent. Fog is most often associated with warm moist air blowing over a relatively cold sea with winds between southeast and southwest. In the vicinity of the Hywind Scotland Pilot Park Project, the frequency of winter fog is less than 1%. In summer, this increases to a frequency of between 3% and 4%.

The average number of days with fog reported at Peterhead Harbour and Aberdeen (Dyce), based on 11 years of observations from 1996 to 2006, is provided below:

Table 8.1 Fog Reported by Coastal Stations

Station	Average Days with Fog per Year
Peterhead Harbour	29
Aberdeen (Dyce)	48

Therefore, in 8% of days annually, fog was recorded at Peterhead, although this may be for a short period only, not a full 24 hours. This study conservatively assumes a value of 3% annual probability of visibility below 1km.

8.5 Tide

A description of the tidal streams in the general area of the east coast of Scotland is provided below, extracted from Admiralty Sailing Directions (UKHO, 2009):

The offshore stream runs generally N and S from Rattray Head to Bell Rock. The E-going stream out of the S part of Moray Firth sets in the direction of the coast, that is gradually SE and S round Rattray Head before joining the S-going offshore stream. The N-going offshore stream divides N of Rattray Head, part of it sets NW and W into Moray Firth and part of it continues N.

The change from the S-going to the N-going stream is through W and from the N-going to the S-going stream through the E.

Tidal levels for Peterhead above Chart Datum are presented below.

Table 8.2 Tidal Levels above LAT

Tidal Level	Height above Chart Datum
Mean High Water Springs (MHWS)	4.0m
Mean High Water Neaps (MHWN)	3.2m
Mean Sea Level (MSL)	2.4m
Mean Low Water Neaps (MLWN)	1.6m
Mean Low Water Springs (MLWS)	0.7m

Figure 8.3 presents the four tidal diamonds from Admiralty Chart 1409-0 (Buckie to Arbroath), in the vicinity of the Hywind Scotland Pilot Park Project. At all four locations the tidal stream runs in a generally north direction at -6 and -5 hours before high water, then generally south for the remainder of the flood tide and at high water. On the ebb, the tidal stream returns to a generally north direction at +1 to +2 hours after high water. The highest mean peak spring tidal rate is 2.2 knots (Diamond “M” during the ebb tide) and the highest mean peak neap rate is 1.2 knots (Diamond “M” during the ebb and flood tide).

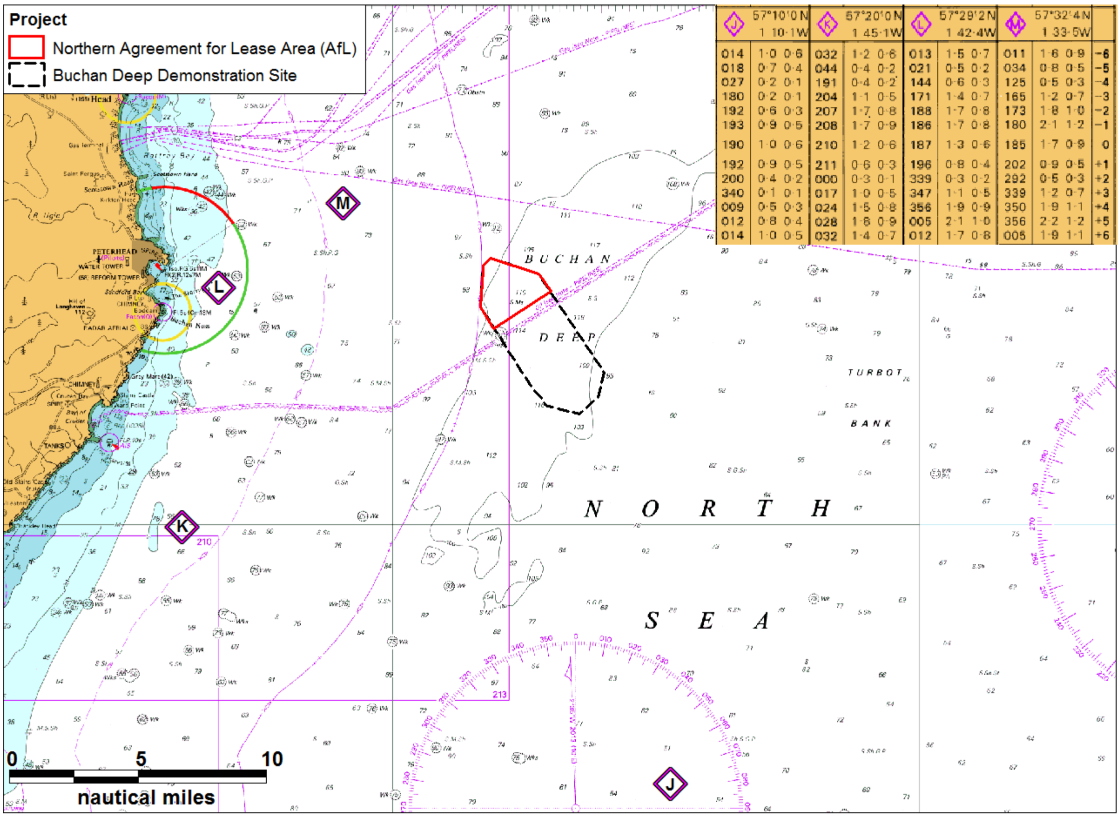


Figure 8.3 Tidal Stream Data

9. EMERGENCY RESPONSE OVERVIEW AND ASSESSMENT

9.1 Introduction

The following sections identify current response capabilities delivered by the UK emergency response providers.

(A detailed review of the historical incidents in the area, including RNLI launches, is presented in Section 10.)

9.2 MCA including HM Coastguard

At the time of writing, the HM Coastguard (HMCG), a division of the MCA, coordinates SAR through a network of 18 Maritime Rescue Coordination Centres (MRCC).

The Hywind Scotland Pilot Park Project currently lies in the former Scotland and Northern Ireland Search and Rescue Region with the nearest MRCC to the proposed Hywind Scotland Pilot Park Project being Aberdeen. MRCC Aberdeen's area of responsibility covers the area south of Brora to the Scotland / England border.

The MCA published a consultation document in December 2010 (MCA, 2010) in order to modernise HMCG. The main part of the document proposes the reduction in the number of MRCC stations around the UK coastline.

Revised plans were released by the UK Government (MCA, 2011) mid-way through 2011 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 Segensworth, near Fareham in Hampshire, 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 Maritime Rescue Sub-Centres (MRSC), 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
- MRSC Humber

*NB: The station at London will be retained unchanged.

The location of the MRCC at Aberdeen in relation to the Hywind Scotland Pilot Park Project is presented in Figure 9.1.

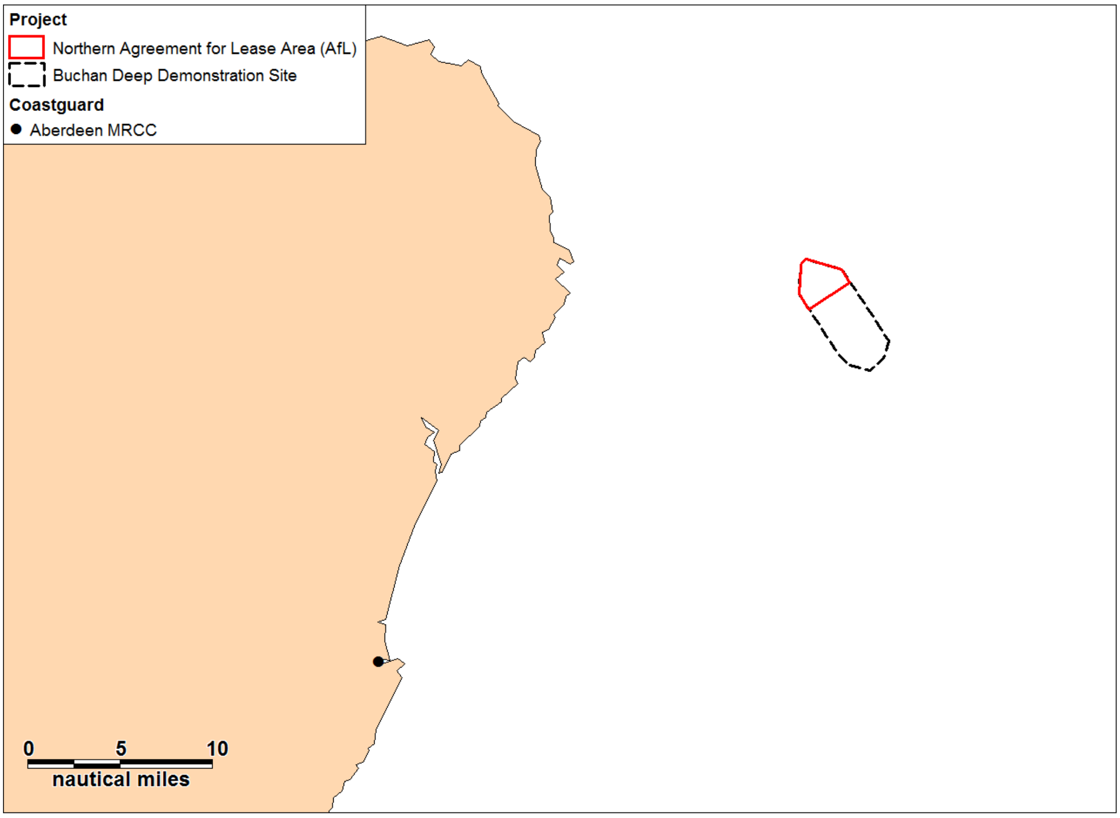


Figure 9.1 Aberdeen MRCC relative to the Hywind Scotland Pilot Park Project

It is noted that the modernisation of the MCA and HMCG is not intended to be a reduction in emergency response facilities but an improved method of coordination and control. Therefore, the MCA expect no impact on the level of response provided in the area. As per MCA guidance, however, a level of self-help, in addition to the national emergency response capability, will be required at the proposed Hywind Scotland Pilot Park Project.

9.3 SAR Resources

9.3.1 SAR Helicopters

A review of the assets in the vicinity of the Hywind Scotland Pilot Park Project indicate that the closest SAR helicopter base is located at Lossiemouth, 64nm west-northwest of the northwest corner of the Hywind Scotland Pilot Park Project, operated by the Royal Air Force (RAF). This base has Sea King helicopters with a top speed of 125 knots and radius of action up to 250nm, which is well within the range of the Hywind Scotland Pilot Park Project. 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.

Up to 19 passengers can be carried, however this is dependent on weather conditions and the distance of the incident from the helicopter's operating base. All SAR helicopters are equipped with Very High Frequency (VHF) (Marine and Air Band), Ultra High Frequency (UHF) and High Frequency (HF) radios. They are also capable of homing to all international distress frequencies.
Based on the above information, the day-time response to the Hywind Scotland Pilot Park Project will be in the order of 45 minutes. At night-time this will increase by 30 minutes to approximately 1 hour 15 minutes due to the additional response time at the base. It is noted that these calculations are based on still air and will vary depending on the prevailing conditions.

Under new helicopter search and rescue plans, however, this base is due to close and be replaced with a new service by summer 2017. The Bristow Group will take over helicopter search and rescue operations, with a contract running for ten years from 2015. Inverness is located approximately 86nm west of the boundary of the Hywind Scotland Pilot Park Project. This base will operate two Sikorsky S-92s which have a maximum cruise speed of 151 knots and range of 539nm. This will cover the Hywind Scotland Pilot Park Project.

The base will be operational 24 hours a day, but details of readiness times are unknown. The response time from the base at Inverness to the Hywind Scotland Pilot Park Project will be 34 minutes plus the readiness time.

Figure 9.2 presents the locations of the current Lossiemouth base and the future Inverness SAR Helicopter base in relation to the Hywind Scotland Pilot Park Project.

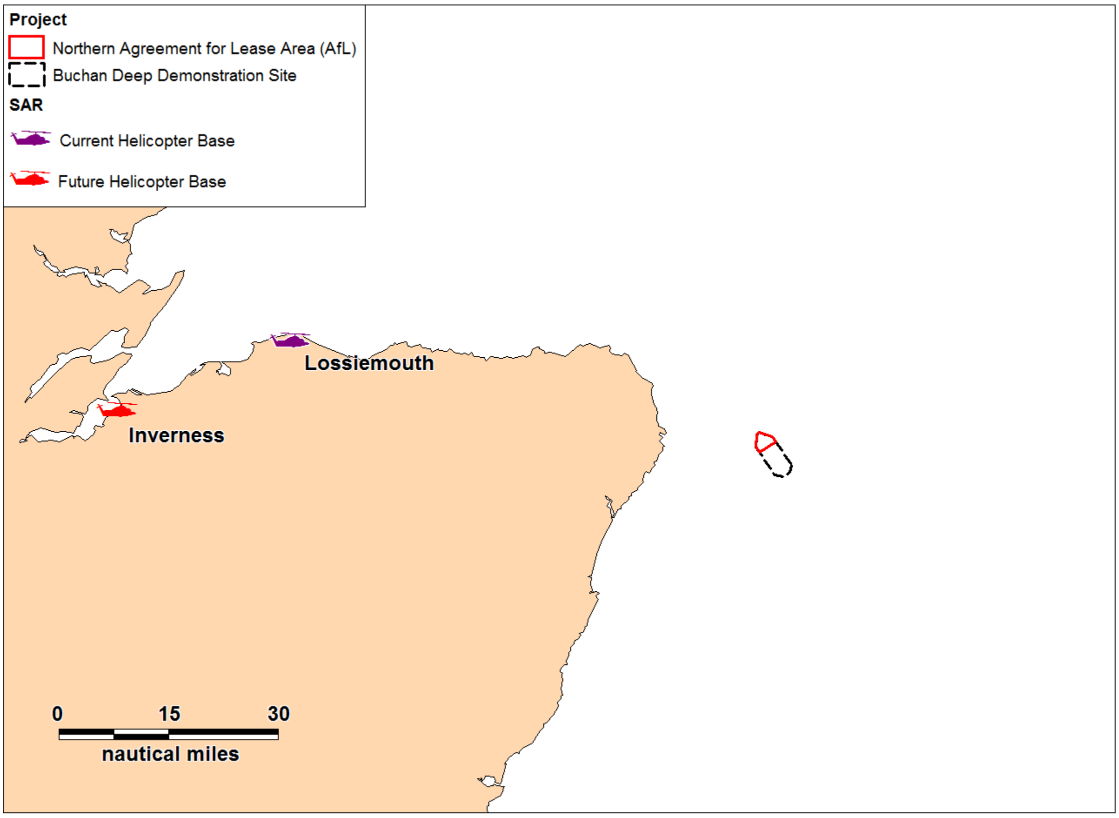


Figure 9.2 Current & Future SAR Helicopter Bases relative to the Hywind Scotland Pilot Park Project

9.3.2 Emergency Towing Vessels, Fires and Salvage

The MCA has an emergency towing vessel (ETV), *Herakles*, situated in Orkney. However, this is on a temporary contract and will cease operation in 2015. Private towing companies may be tasked to assist a drifting vessel.

The responsibility for dealing with fires on vessels lies with the vessel's operating company. The vessel's operating company is obligated to have a safety management system in place. The HMCG will monitor any situation for risk to life or marine pollution. SAR assets will be tasked to assist if the fire has not been dealt with or commercial salvers tasked to assist in saving the vessel and cargo if required.

Private salvage companies may be tasked by the MCA for a variety of activities including wreck removal, cargo recovery, towage and pollution defence. These private vessels are situated throughout UK waters and ports waiting to be tasked.

9.3.3 Coastguard Agreement on Salvage and Towage (CAST)

Where there is a serious risk of harm to persons or property, or a significant risk of pollution, it may be necessary to initiate emergency towing arrangements. Such arrangements should be unambiguous, agreed by all parties where possible, and activated as swiftly as practicable.

The MCA has a framework agreement with the British Tugowners Association (BTA) for emergency chartering arrangements for harbour tugs. The agreement covers activation, contractual arrangements, liabilities and operational procedures, should the MCA request assistance from any local harbour tug as part of the response to an incident. Modern harbour tugs are often capable of providing an effective emergency service in all but the worst weather conditions, and to the largest vessels. The UK towage industry has invested heavily over recent years in powerful omni-directional tugs typically of over 50 tonnes bollard pull and with fire-fighting capability. Where weather conditions or size of casualty restrict their use, such tugs can also perform a useful task in providing first response prior to the arrival of other more suitable vessels.

It is noted that only one small harbour tug is stationed at Peterhead Port for vessels up to 120m length. Larger tugs are normally available at 24 hours' notice. However, there tends to be a higher than normal level of towage vessel capability in the Hywind area due to the oil & gas support vessel routes between the North Sea and onshore bases at Aberdeen and Peterhead. Availability will fluctuate, such tugs may not be altogether suitable for emergency towage and weather / tide conditions may restrict their use.

9.3.4 Pollution Control and Clean-Up

Any incident of marine pollution or the possibility of pollution must be reported to the nearest MRCC station which will inform the duty counter pollution and salvage officer which determines the level of response – local, regional or national. A local response is a situation that can be dealt with by one authority not requiring assistance from any other authorities. Regional and national responses are required when a significant pollution spill occurs requiring a salvage operation, a spill that requires the deployment of vessels or aircraft to assist in dispersal or during a spill that the local authority does not have the capability to respond to adequately and requires assistance from the MCA.

The initial goal if possible is to prevent pollution, the second step is to stop any further pollution through containment and the third is to minimise environmental hazards.

The MCA may deploy air borne or sea borne equipment to disperse or neutralise the pollution if the installation or the vessel does not have the capability to do so. Commercial salvers can be tasked to perform suitable salvage operations with the goal of minimising pollution.

9.3.5 MCA Tiered Response for Pollution

For the purpose of planning, tiers are used to categorise oil pollution incidents. The tiered approach to oil pollution contingency planning identifies resources for responding to spills of increasing magnitude and complexity by extending the geographical area over which the response is coordinated:

- Tier 1 Local (within the capability of one local authority, harbour authority or development);
- Tier 2 Regional (beyond the capability of one local authority or development); and
- Tier 3 National (requires national resources).

9.3.6 Secretary of States' Representative for Salvage and Intervention

The role of the Secretary of States' Representative for Salvage and Intervention (SOSREP) is to represent the DfT (in relation to ships) and the DECC (in relations to offshore installations) by removing or reducing the risk to safety, property and the UK environment arising from accidents involving ships, fixed or floating platforms or sub-sea infrastructure. SOSREP's powers extend to UK territorial waters (12 nautical miles from the coast/baseline) for safety issues and to the UK Pollution Control Zone (200 miles or the median line with neighbouring states) for pollution.

9.3.7 RNLI Lifeboats

The RNLI maintains a fleet of over 340 lifeboats of various types at 236 stations around the coast of the UK and Ireland. The RNLI stations in the vicinity of the Hywind Scotland Pilot Park Project are presented in Figure 9.3.

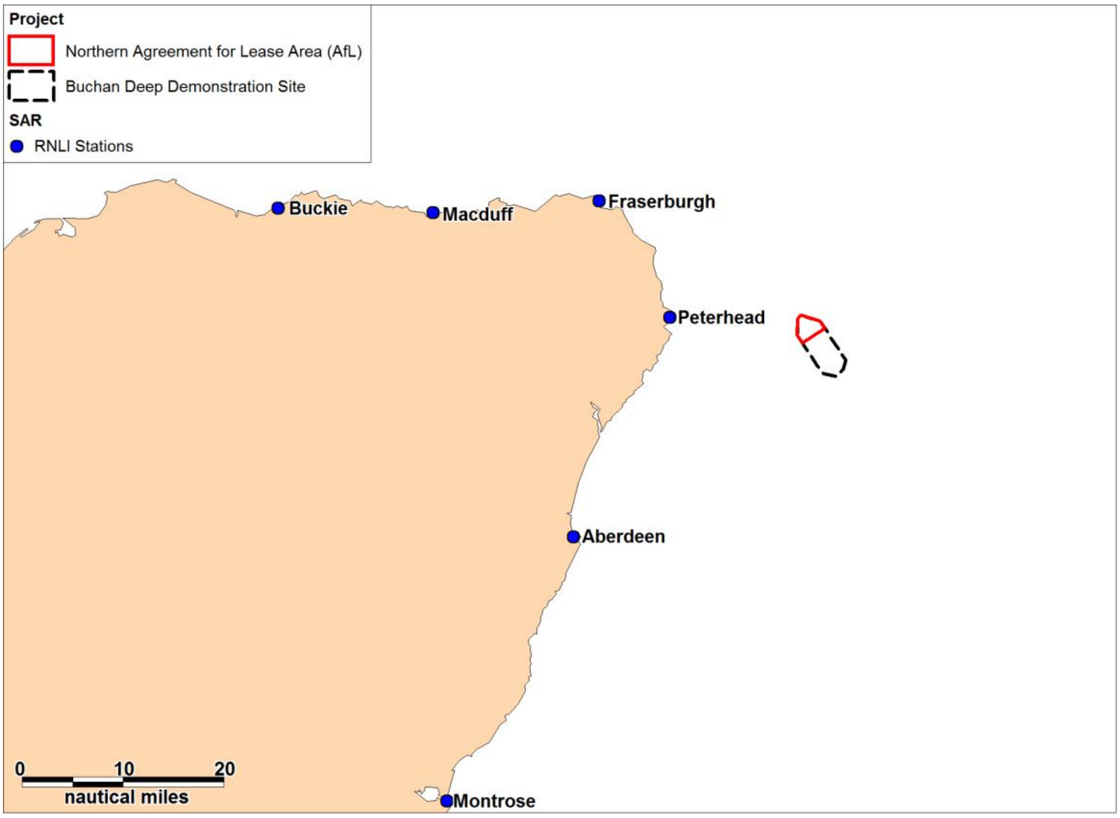


Figure 9.3 RNLI Bases in the vicinity of the Hywind Scotland Pilot Park Project

Table 9.1 provides a summary of the facilities at the closest RNLI bases to Hywind, which are shown in the incident review in Section 10 to be the ones most likely to respond to an incident in the vicinity of the Project. At each of these stations crew and lifeboats are available on a 24 hour basis throughout the year.

Table 9.1 Lifeboats at RNLI Stations in the vicinity of the Hywind Scotland Pilot Park Project

Station	Lifeboat Type	Name	Approx. Distance to Project by Sea (nm)
Peterhead	ALB Tamar	The Misses Robertson of Kintail	13

Station	Lifeboat Type	Name	Approx. Distance to Project by Sea (nm)
Fraserburgh	ALB Trent	Willie & Nay Gall	23

The nearest RNLI station relative to the Project is Peterhead, where a Tamar class all-weather lifeboat (ALB) is available. The Tamar class lifeboat, *The Misses Robertson of Kintail*, is 16.3m in length and has a maximum speed of 25 knots. The average response time declared by the RNLI for an ALB is 14 minutes. 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 ALB from Peterhead to reach the western boundary of the Hywind Scotland Pilot Park Project would be approximately 45 minutes (taking into account a 14 minute callout time).

9.4 Wind Farm SAR Matters

The Hywind Scotland Pilot Park Project 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 (MCA, 2008a).

This includes the development of an Emergency Response Cooperation Plan (ERCoP) for the Hywind Scotland Pilot Park Project, which will be in place prior to construction being undertaken. It has been requested by Marine Scotland that a draft ERCoP be submitted with the Marine Licence application.

An outline of the contents of an ERCoP based on guidance provided by the MCA is as follows:

- Details of the company,
- The installations to be built,
- The MRCC,
- SAR facilities and their response capability,
- Criminal actions and accidents to persons,
- Media relations,
- Emergency management and response exercises,
- Unexploded ordnance and wreck materials located on or near OREIs,
- Counter pollution; and
- Liaison.

Examples of features to be incorporated into the Project are as follows:

<u>Design:</u>

- All WTG Units and other will each 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.

- The identification characters 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 identification characters 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 3 metres above sea levels, and at a distance of at least 150 metres from the turbine.

Operation:

- The Central Control Room, or mutually agreed single contact point, will be manned 24 hours a day.

- Coastguard and RNLI will be advised of the contact telephone number of the Central Control Room, or single contact point (and vice versa)

- The control room operator, or single contact point, will immediately initiate the shut-down procedure for WTG Units as requested by the Coastguard, and maintain the WTG Unit in the appropriate shut-down position, as requested by the Coastguard, until receiving notification that it is safe to restart the WTG Unit.

9.5 Additional SAR Commitments

HSL commits to:

- Assess the risks associated with the wind farm in line with their Safety Management System and use this assessment to form the basis for identifying scenarios to be considered within their emergency planning process.

- Endeavour to involve all appropriate parties in the forming of emergency response plans and operational procedures. This will include staff, appropriate contractors and external organisations such as:

    - MCA / HMCG
    - RNLI
    - MoD
    - Tug companies
    - Fire Brigade
    - Police

- Ensure all those involved in emergency response within the Hywind Scotland Pilot Park Project are trained and competent.

- Prepare a written Personal Protective Equipment (PPE) program for use by all employees working at the wind farm and for those involved in emergency response.

- Apply Best Available Technology Not at Excessive Cost (BATNEC) principles to ensure the equipment used to support emergency response is appropriate.

- Conduct emergency response trials under realistic conditions to maintain competence and further improve system using any knowledge gained.

- Maintain suitable records of emergency responses to be used to further improve systems within HSL and the industry. HSL is committed to sharing this type of information with other companies within the wind farm industry to help improve safety. (Statoil is a member of the G9 Offshore Wind Health and Safety Association.)

Finally, it is noted that wind farm projects can also have a positive impacts on SAR operations. Infrastructure and vessels related to the project lead to an increased human presence offshore. This could be useful in a search and rescue situation, especially if wind farm vessels can be temporarily requisitioned to assist in SAR operations. Increased radar and charting in the area could also aid SAR.

10. MARITIME INCIDENTS

10.1 Introduction

This section reviews maritime incidents that have occurred in the vicinity of the Pilot Park in recent years. Data are presented for the previously defined Pilot Park Study Area (i.e. original Exclusivity Area with a 10nm buffer, which provides ample coverage).

The analysis is intended to provide a general indication as to whether the area of the proposed development 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 development could exacerbate the existing maritime safety risks in the area.

The most recently available 10 years of data from the following sources has been analysed:

- MAIB (2003-2012); and
- RNLI (2001-2010).

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

10.2 MAIB

All UK-flagged commercial vessels are required to report accidents to MAIB. Non-UK flagged vessels do not have to report unless they are within a UK port / harbour or are within UK 12 mile 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, harbour authorities and inland waterway authorities also have a duty to report accidents to the MAIB.

The locations[2] of accidents, injuries and hazardous incidents reported to MAIB within the Pilot Park Study Area between January 2003 and December 2012 are presented in Figure 10.1, thematically mapped by type.

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

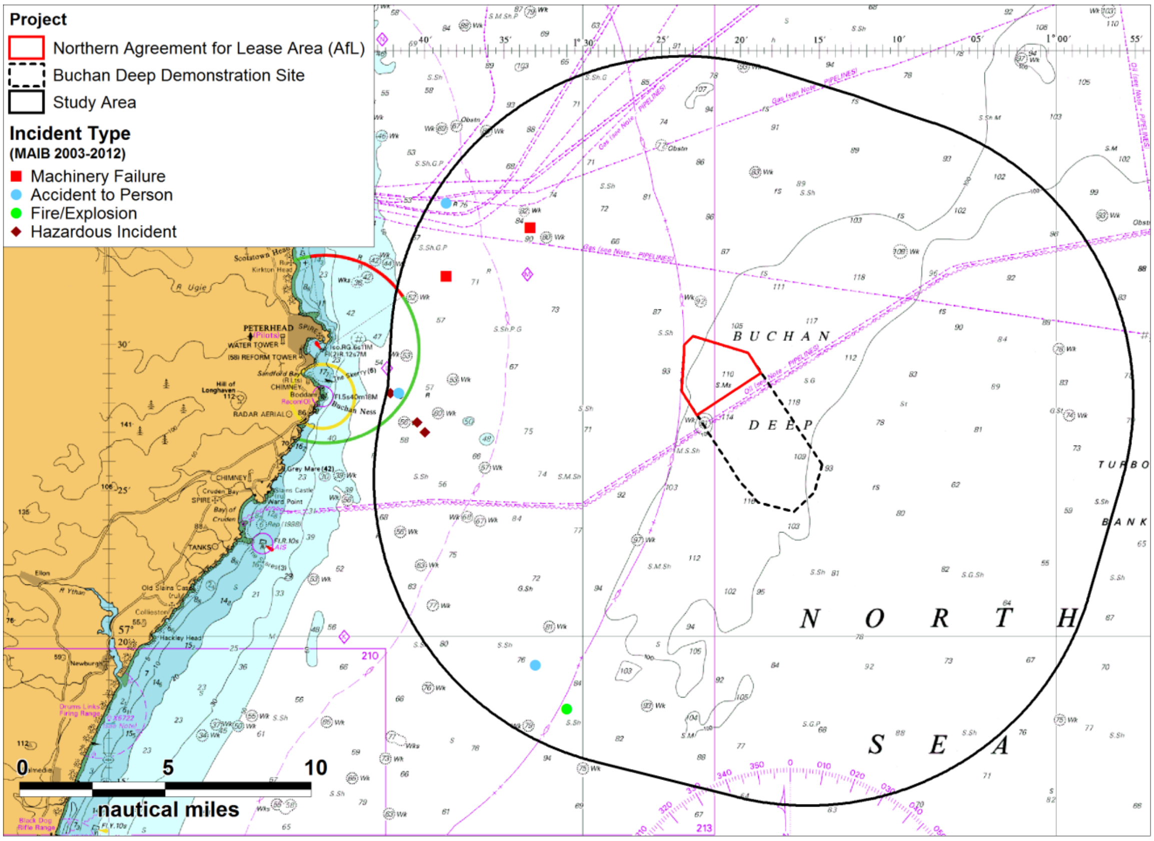


Figure 10.1 MAIB Incident Locations by Type within Pilot Park Study Area

A total of nine unique incidents involving nine vessels were reported in the Pilot Park Study Area, corresponding to an average of just under one per year. No incidents were reported within the Northern AfL area.

The overall distribution by incident type, vessel type and year is presented in Figure 10.2, Figure 10.3 and Figure 10.4 respectively.

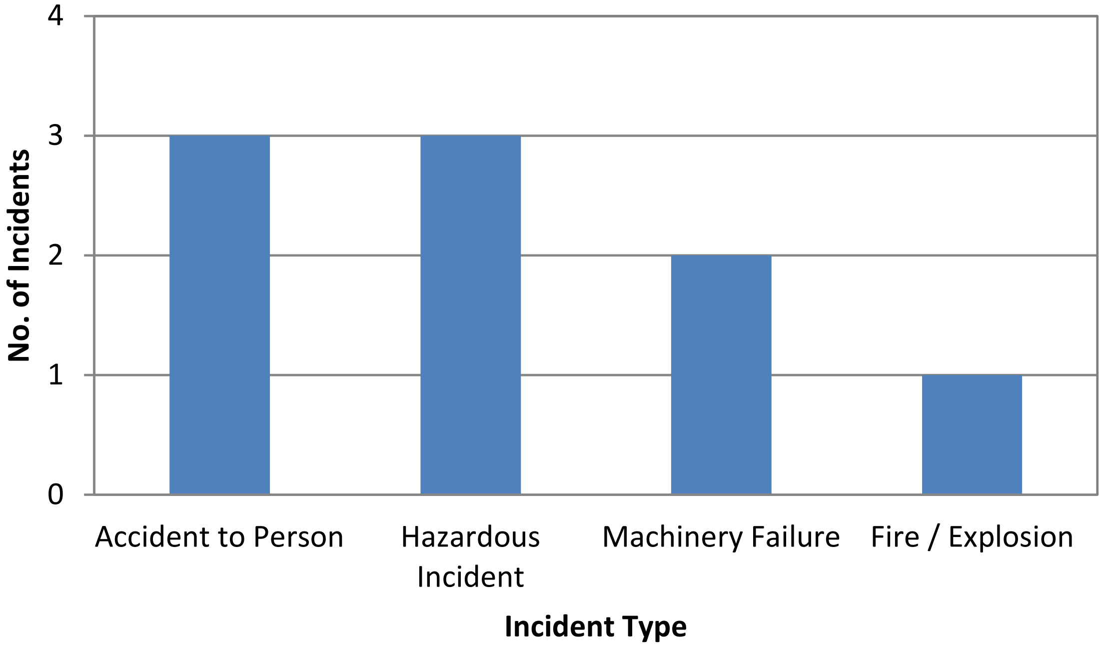


Figure 10.2 MAIB Incidents by Type within Pilot Park Study Area (2003-12)

The most common type of incidents were accident to person and hazardous incident[3] (near-misses), each representing 33% of all incidents.

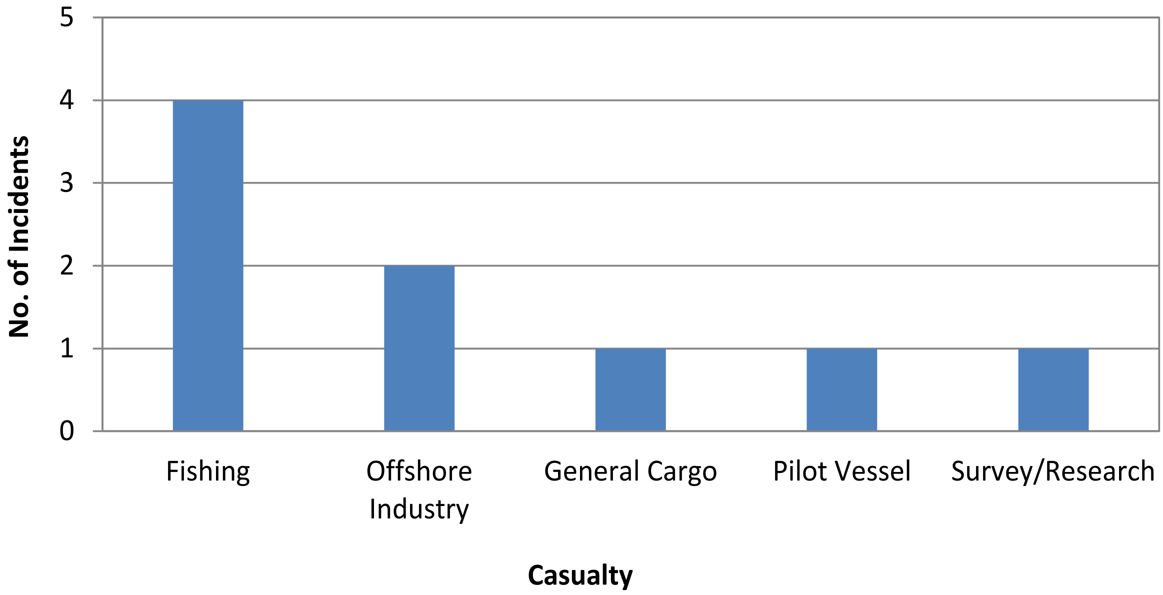


Figure 10.3 MAIB Incidents by Casualty Type within Pilot Park Study Area (2003-12)

[3] Unspecified events which might have led to an accident, e.g., near misses stemming from failure of procedures in shipboard operations, material defects, fatigue and human failures.

Fishing vessels (44%) were the most commonly involved in incidents, followed by offshore industry vessels (22%).

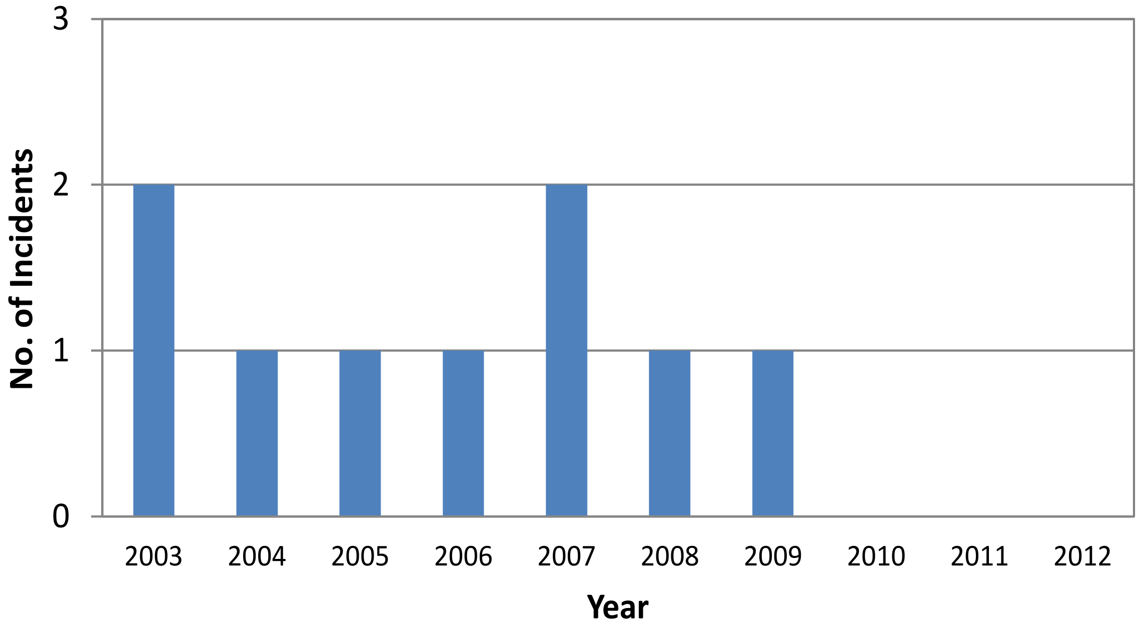


Figure 10.4 MAIB Incidents by Year within Pilot Park Study Area (2003-12)

In terms of yearly variations, it can be seen that the number of incidents fluctuated from none to two within the period analysed. The latest three years of analysed data were incident free.

No incidents were reported within the Northern AfL area. The closest incident was recorded approximately 6.6nm north-west of the Northern AfL area and involved a machinery failure on board a fishing trawler. The incident took place on 24 August 2007 while the vessel was on passage.

10.3 RNLI

Data on RNLI lifeboat responses within the Pilot Park Study Area in the ten-year period between 2001 and 2010 have been analysed (the most recent ten year period available). A total of nine launches, all to unique incidents, were recorded by the RNLI (excluding hoaxes and false alarms). This corresponds to an average of just under one incident per year.

Figure 10.5 presents the geographical location of incidents thematically mapped by casualty type.

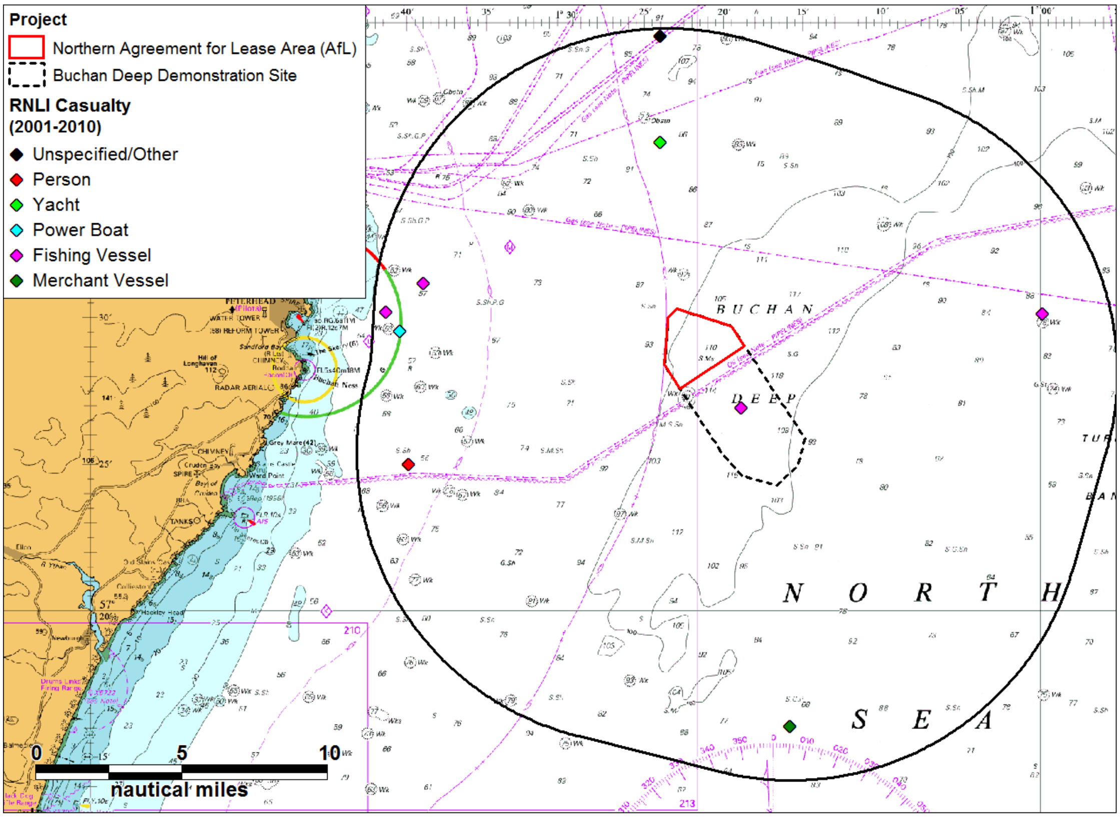


Figure 10.5 RNLI Incidents by Casualty Type within Pilot Park Study Area

The overall distribution by casualty type is summarised in Figure 10.6.

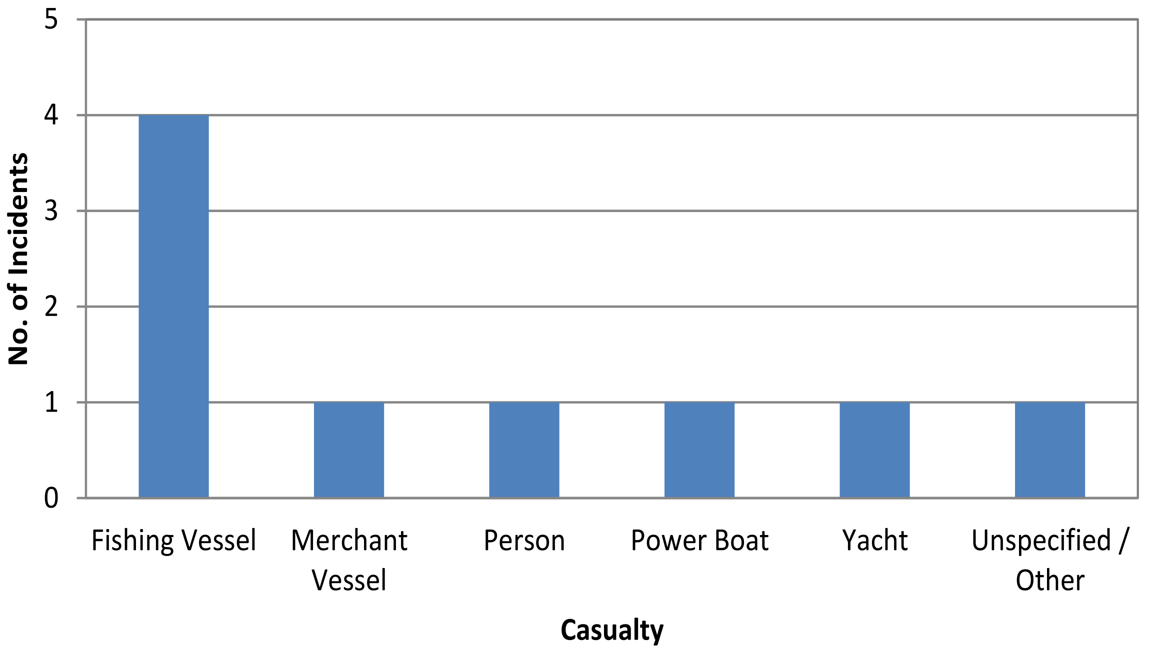


Figure 10.6 RNLI Incidents by Casualty Type within Pilot Park Study Area (2001-2010)

Overall, the most common vessel types involved were fishing vessels (44%). Merchant vessel, person, power boat, yacht and unspecified represented one incident each.

A chart of the incidents thematically mapped by cause is presented in Figure 10.7.

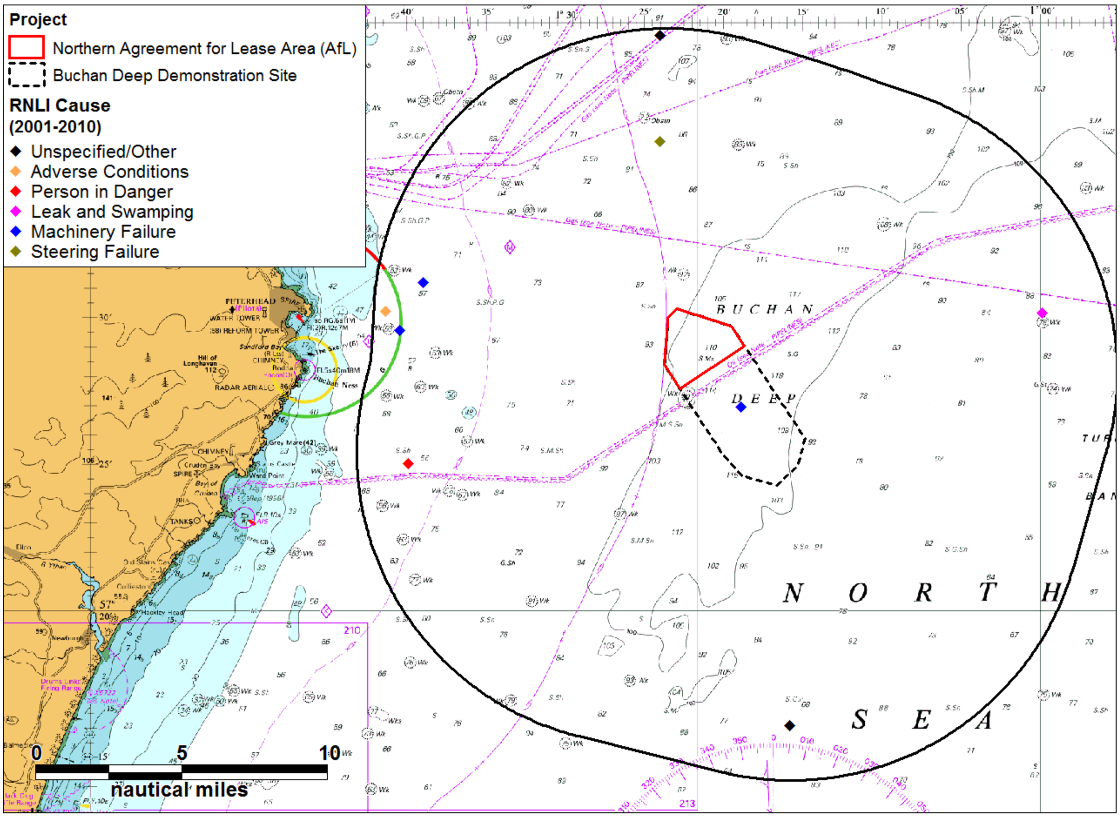


Figure 10.7 RNLI Incidents by Cause within Pilot Park Study Area

The reported causes are summarised in Figure 10.8. The main cause of incidents was machinery failure (44%).

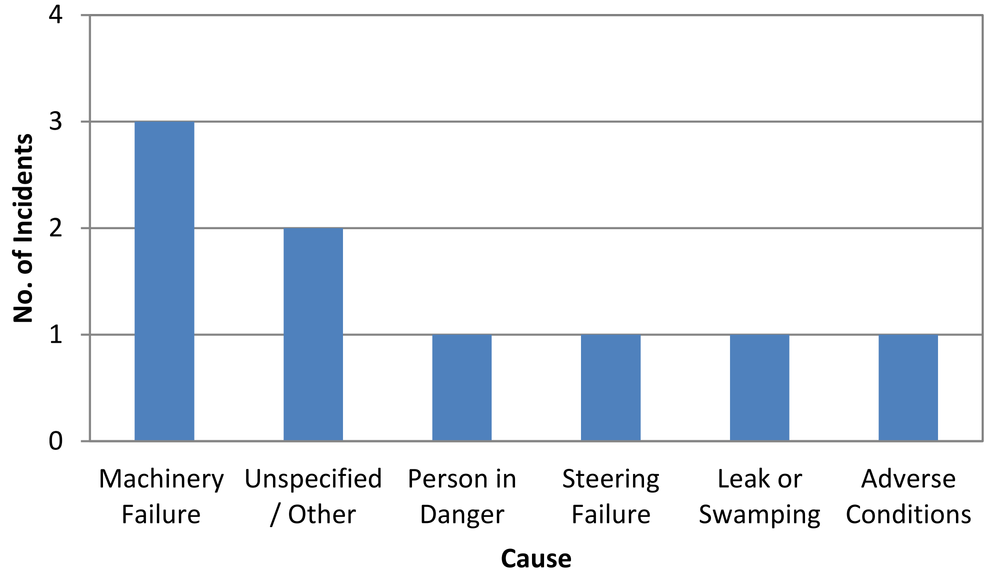


Figure 10.8 RNLI incidents by Cause within Pilot Park Study Area (2001-10)

The annual rate of incidents in the past ten years is summarised in Figure 10.9.

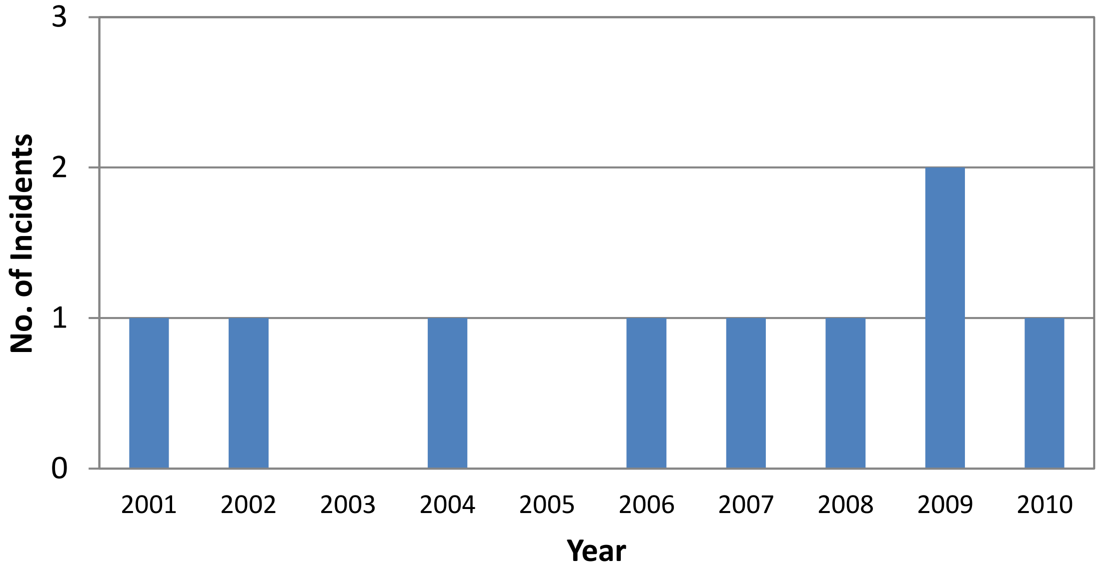


Figure 10.9 RNLI incidents by Year within Pilot Park Study Area (2001-10)

There was one incident per year in the Pilot Park Study Area from 2001-2010, except in 2003 and 2005 when there were no incidents, and 2009 when there were two incidents.

All incidents were responded to by the Peterhead RNLI station with one exception, which was responded to by Fraserburgh RNLI. This was the most northerly incident recorded within the Pilot Park Study Area.

There was one incident recorded within the Buchan Deep Demonstration Site over the 10 years analysed. This incident involved a large fishing vessel which suffered a machinery failure on 22 June 2001 and was responded to by Peterhead ALB.

11. MARITIME TRAFFIC SURVEYS

11.1 Introduction

This section presents analysis of the maritime traffic data for the Hywind Scotland Pilot Park Project, using a combination of AIS data and visual observations. Analysis of data was carried out within the Study Area.

It was agreed at the meeting with the MCA and NLB on 26 November 2013 that, given the observations from the *Franklin* survey vessel which showed all fishing vessels in the area were broadcasting on AIS, as well as consultation with SFF on the size of fishing vessels using the area, an extended AIS survey was appropriate to develop the baseline for the Project as opposed to carrying out a dedicated vessel survey. This has been supplemented by visual observations and long-term datasets such as VMS and sightings.

In terms of AIS, the following periods have been used:

- 28 days summer 2013;
- 28 days autumn 2013;
- 28 days winter 2014; and
- 28 days spring 2014.

These four periods encompass seasonal fluctuations in shipping activity and account for a range of tidal conditions. This long-term AIS data exceeds the minimum of four weeks specified in MCA MGN 371.

11.2 AIS Survey Analysis

11.2.1 Vessel Type within Pilot Park Study Area

Plots of the AIS tracks for each of the four 28 day periods, thematically mapped by vessel type, are presented in Figure 11.1 to Figure 11.4. Three vessels, survey vessel *Franklin*, bird survey vessel *Eileen May*, and offshore vessel *Toisa Voyager*, which were carrying out work for the Hywind Scotland Pilot Park Project have been removed from all analysis.

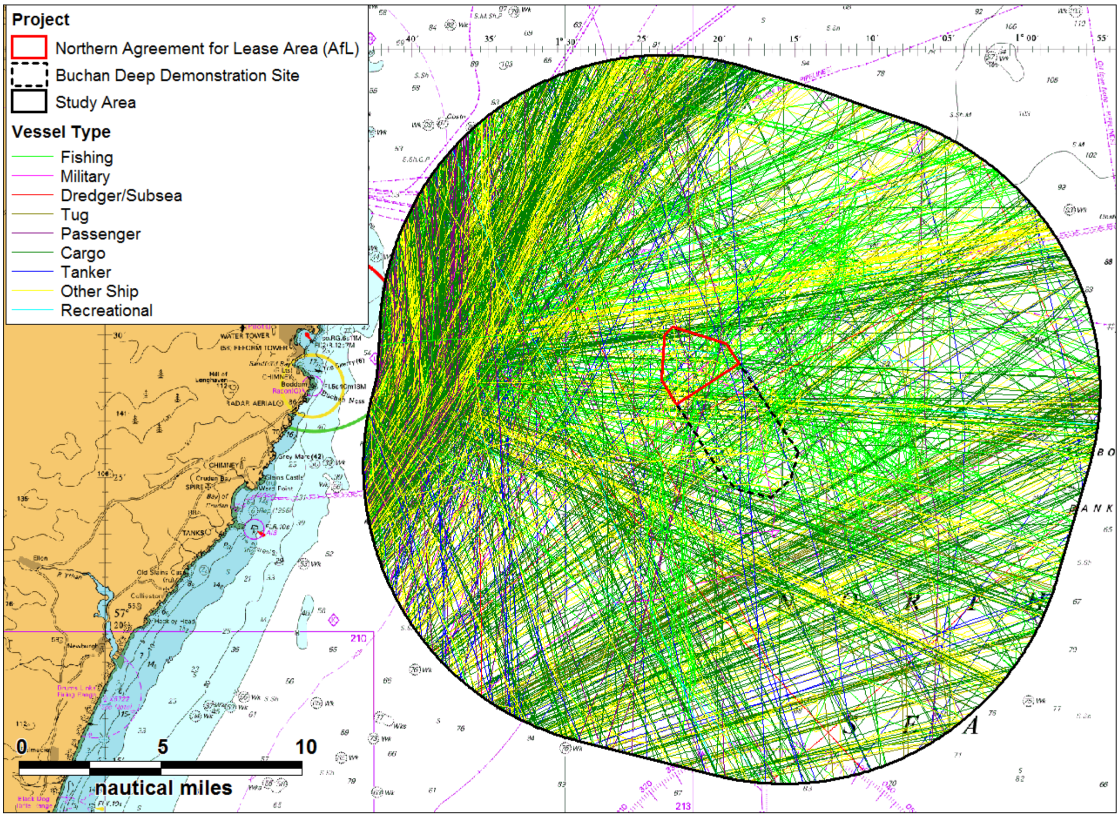


Figure 11.1 Summer 2013 AIS Data (28 Days) within Pilot Park Study Area

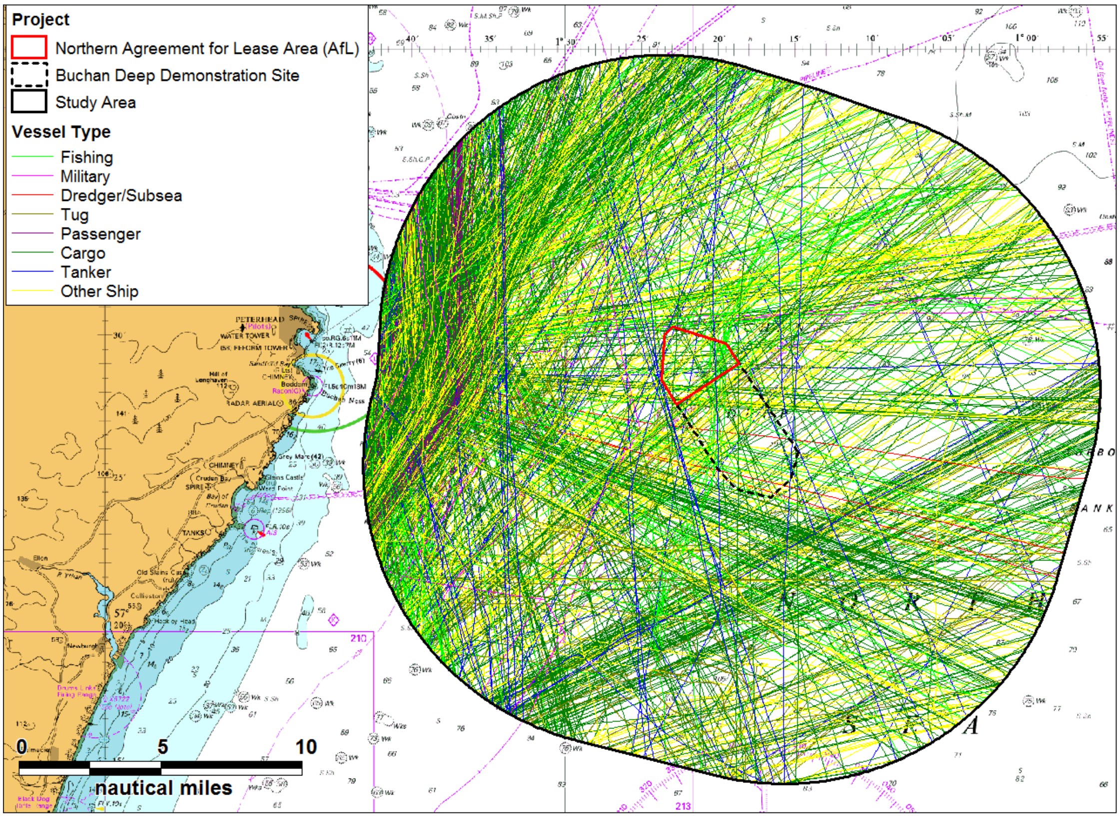


Figure 11.2 Autumn 2013 AIS Data (28 Days) within Pilot Park Study Area

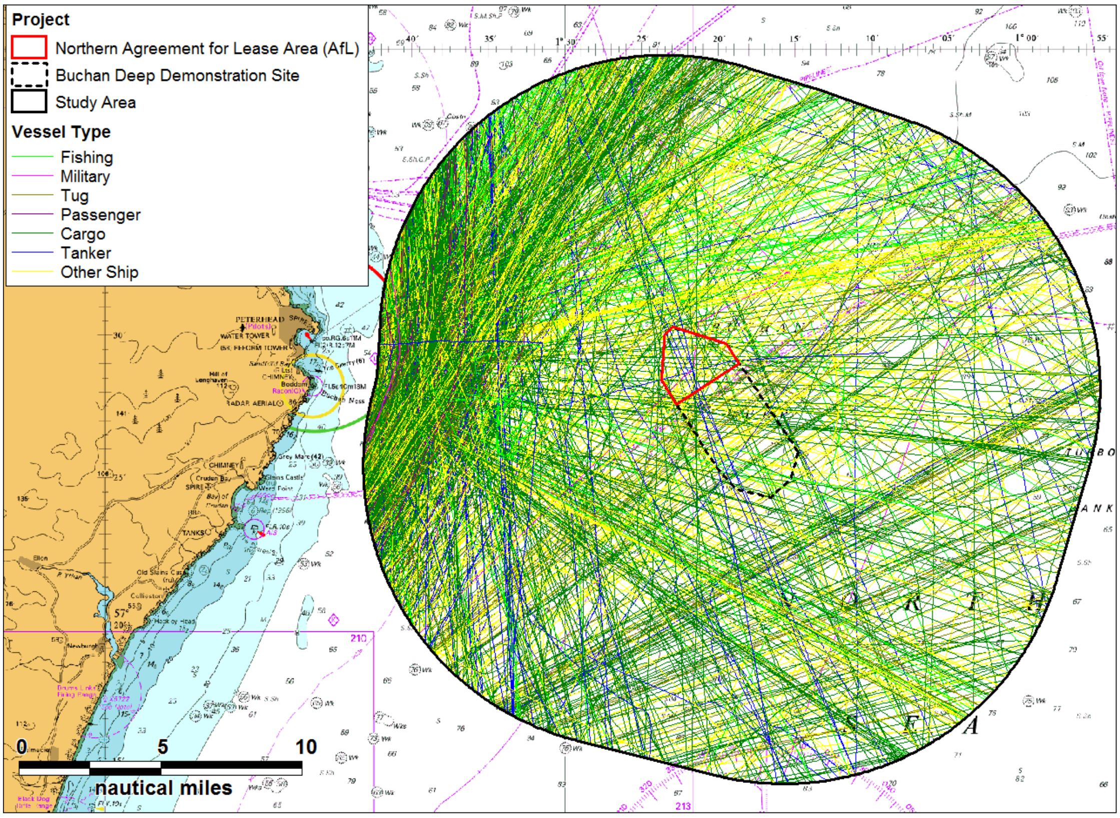


Figure 11.3 Winter 2014 AIS Data (28 Days) within Pilot Park Study Area

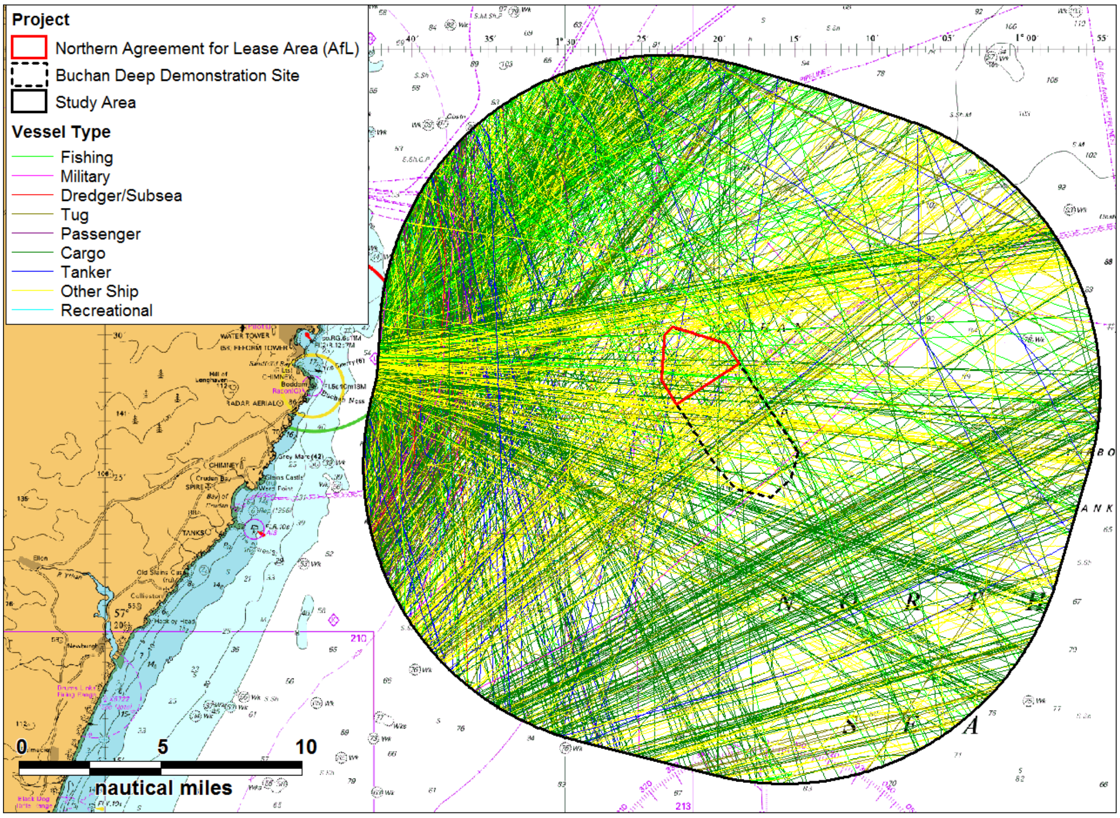


Figure 11.4 Spring 2014 AIS Data (28 Days) within Pilot Park Study Area

The average number of unique vessels per day in each of the four survey periods is presented in Figure 11.5, with Figure 11.6 displaying the vessel type distribution over the four periods.

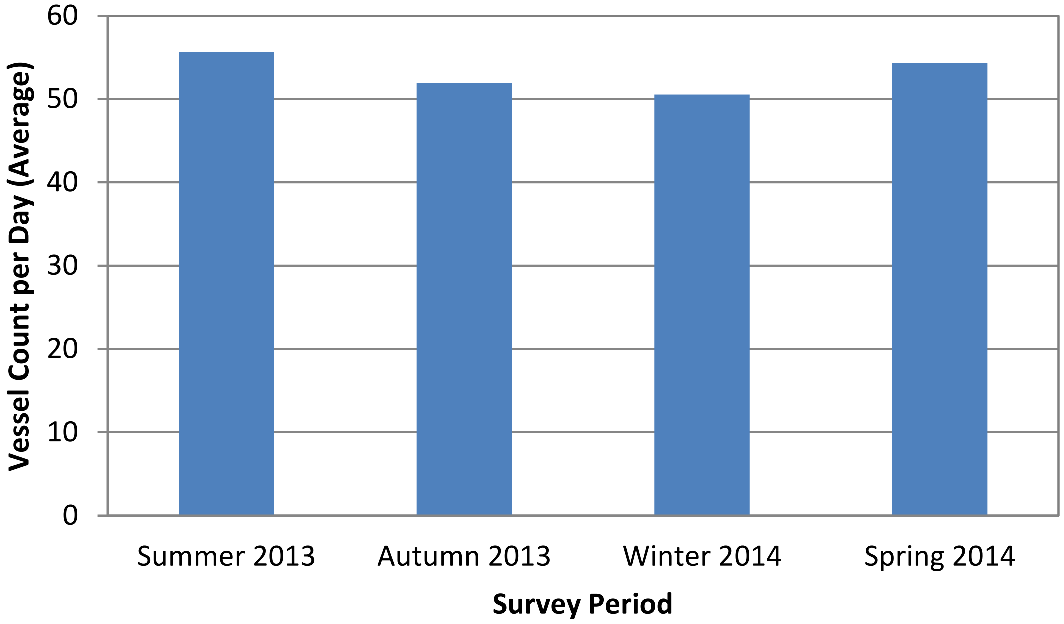


Figure 11.5 Average Daily Vessel Count within Pilot Park Study Area

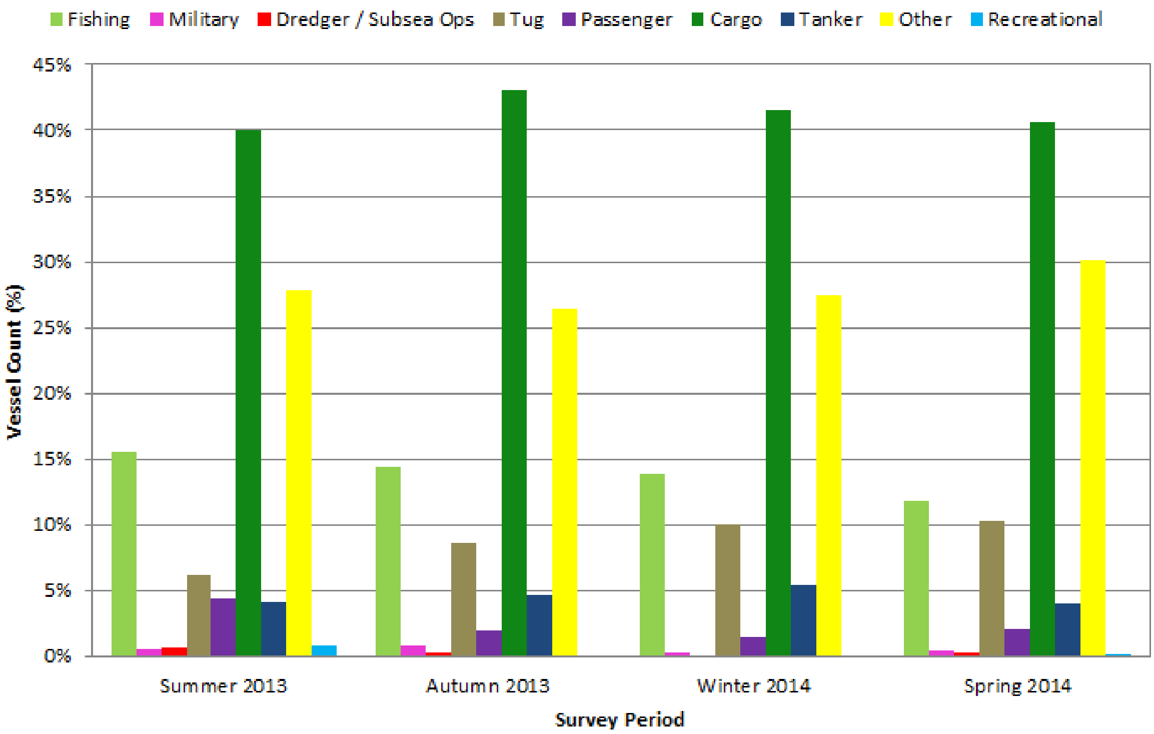


Figure 11.6 Vessel Types identified within Pilot Park Study Area

The level of traffic was fairly regular over the periods, with an average of 50-56 unique vessels per day, slightly higher in summer / spring compared to autumn / winter.

The vessel type distribution did not vary significantly during the four periods. The most common vessels in all four periods were cargo vessels (40%-43%), followed by 'other' vessels (26%-30%).

11.2.2 Vessel Type (with Offshore Category) within Pilot Park Study Area

Further research indicated that the majority of vessels broadcasting their type as cargo and 'other' on AIS were working for the offshore, oil & gas industry. Over the combined 112 day period, 63% of vessels tracked were offshore vessels. This includes supply vessels, Emergency Response and Rescue Vessels (ERRV), anchor handling tugs and fishing vessels working as guard vessels. A plot of the spring 2014 AIS track data with offshore vessels given a unique colour-coding is presented in Figure 11.7.

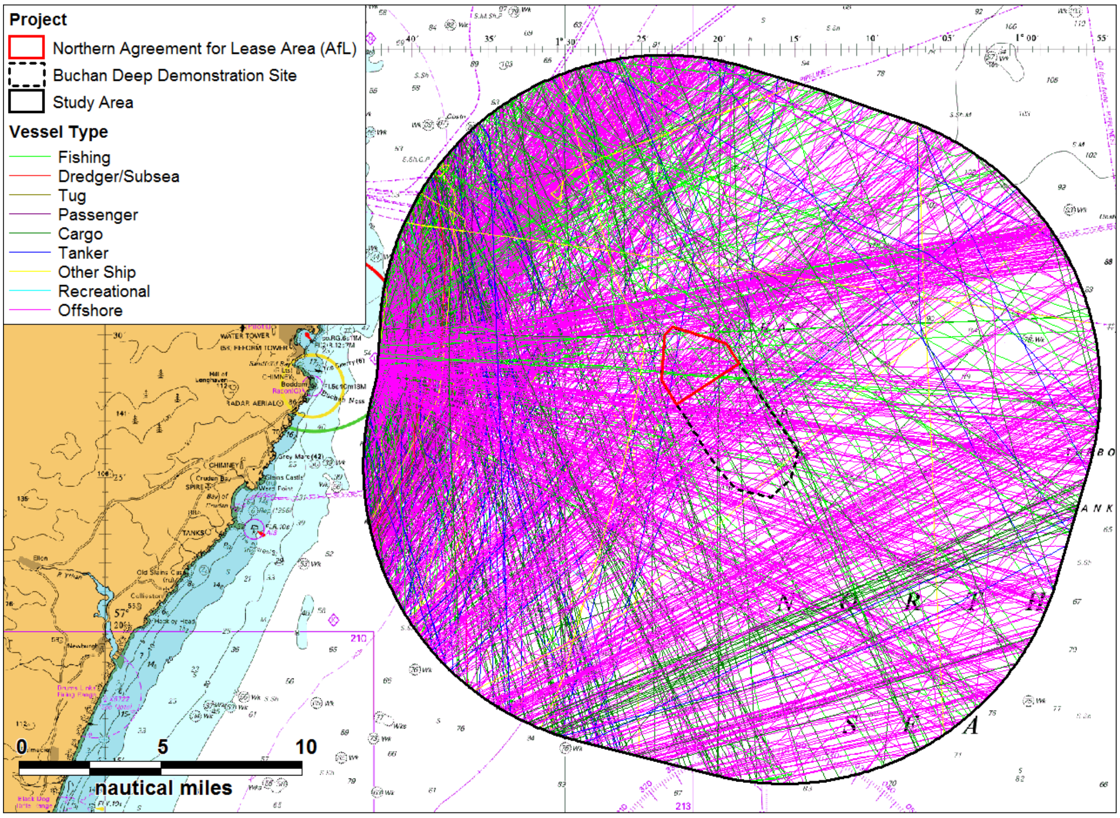


Figure 11.7 Spring 2014 AIS Data (28 Days) within Pilot Park Study Area

Figure 11.8 displays the vessel type distribution with offshore vessels separated into a discrete category, over the four periods.

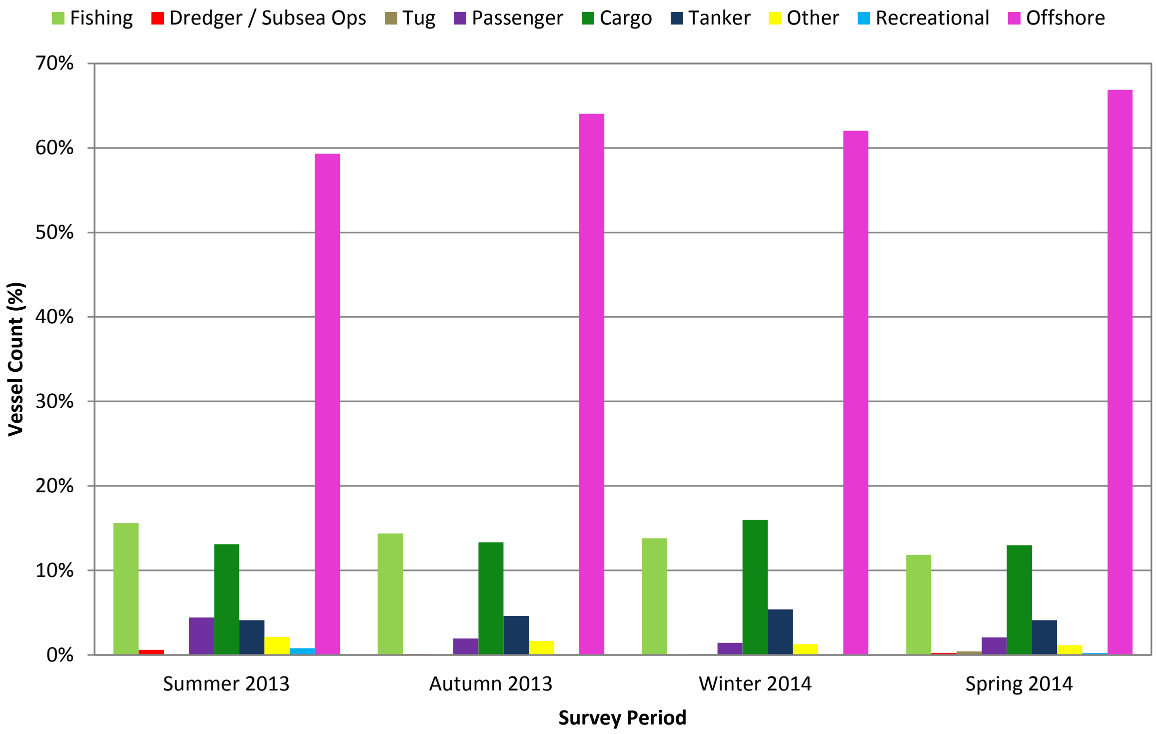


Figure 11.8 Vessel Types identified within Pilot Park Study Area

11.2.3 Passenger and Serco NorthLink Ferries within Pilot Park Study Area

This sub-section reviews the passenger vessel activity in the vicinity of the Pilot Park Study Area based on the maritime traffic survey.

An average of one to two unique passenger vessels per day were recorded on AIS during the 16 weeks survey period. The majority of these (79%) were the SercoNorthlink passenger ferries *Hrossey* and *Hjaltland* operating the timetabled service between Aberdeen and Kirkwall / Lerwick.

Figure 11.9 presents the passenger vessel tracks identified from the surveys, within the Pilot Park Study Area, with the Serco NorthLink passenger vessels highlighted in a different colour.

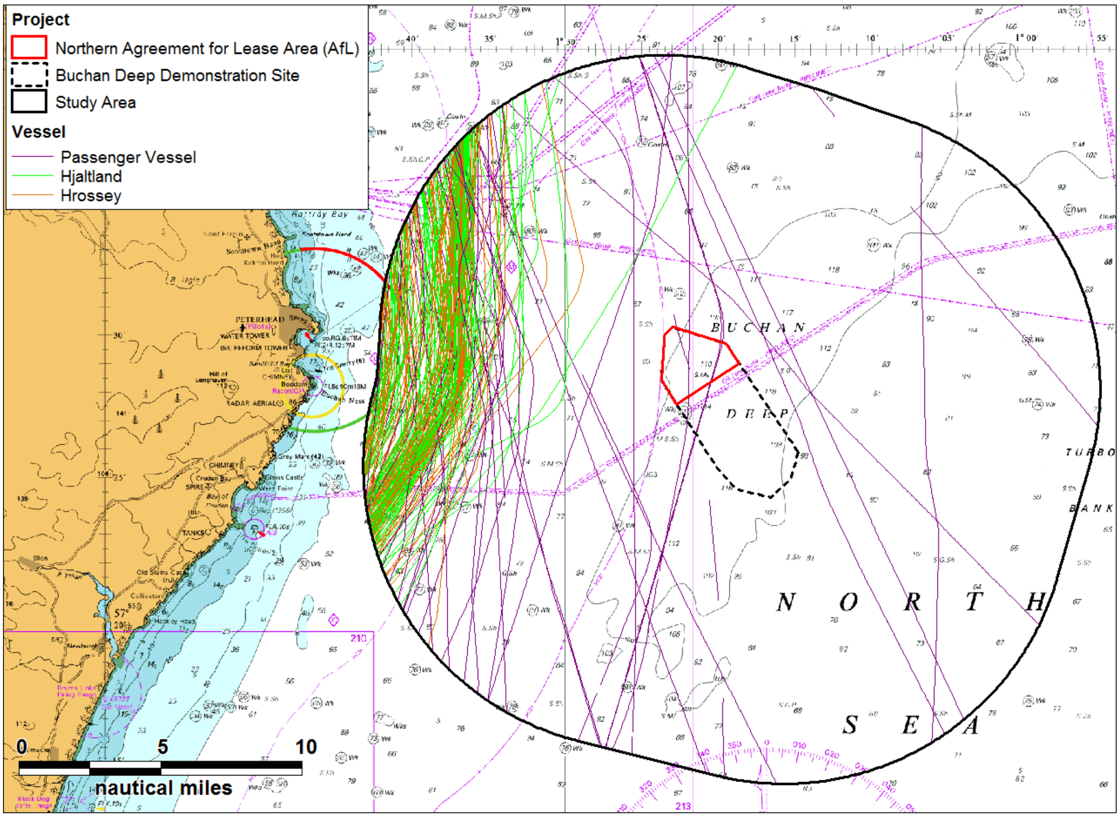


Figure 11.9 Passenger Vessel Survey Tracks within Pilot Park Study Area (16 Weeks AIS)

The majority of the passenger vessels tracked passed to the west of the Pilot Park Study Area, including the NorthLink ferries. These vessels, *Hrossey* and *Hjaltland*, passed on average 7.8nm west of the Northern AfL area, with the closest passage being at 2.3nm. Three passenger vessels transited through the Northern AfL area over the 16 weeks survey, all of which were passenger cruise ships.

Serco NorthLink also operates two freight vessels, *Helliar* and *Hildasay*. These freight ferries normally passed 6-10nm to the west of the Northern AfL area. On one occasion, *Hildasay* was tracked passing at 0.9nm (1700m) west.

11.2.4 Vessel Length within Pilot Park Study Area

Plots of the AIS tracks for each of the four 28 day periods, thematically mapped by vessel length, are presented in Figure 11.10 to Figure 11.13.

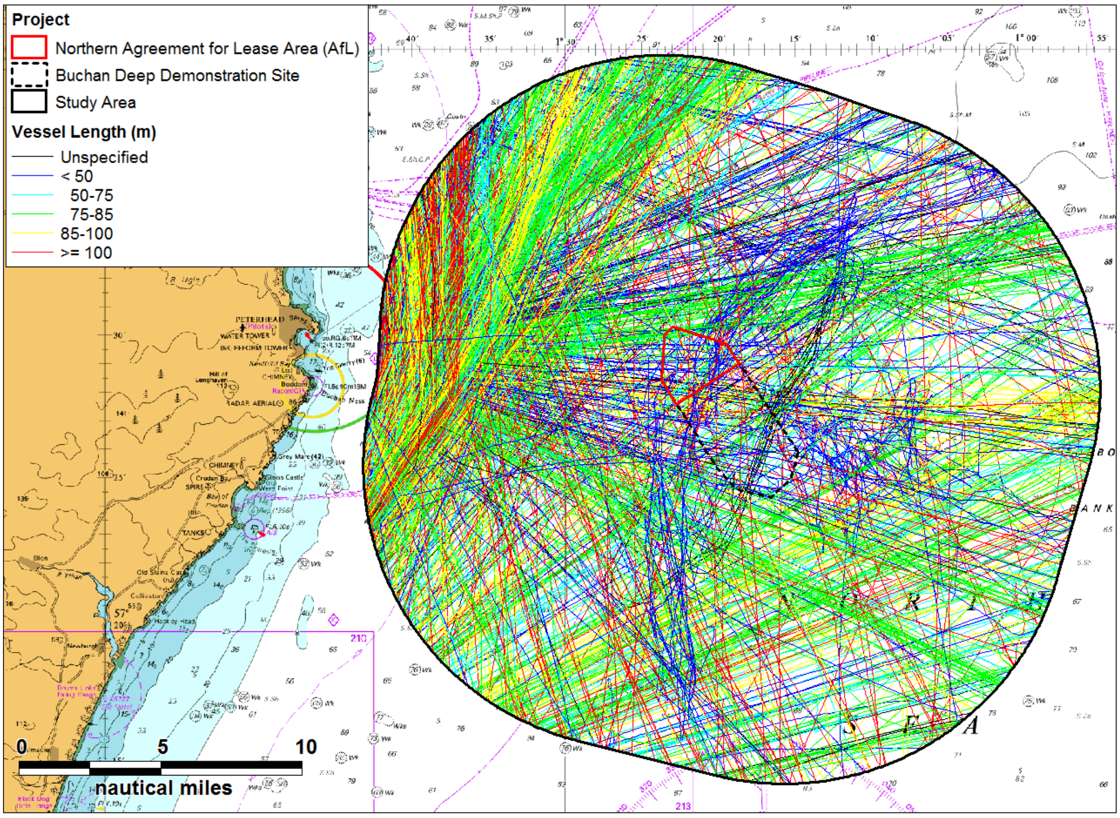


Figure 11.10 Summer 2013 AIS Data (28 Days) by Length

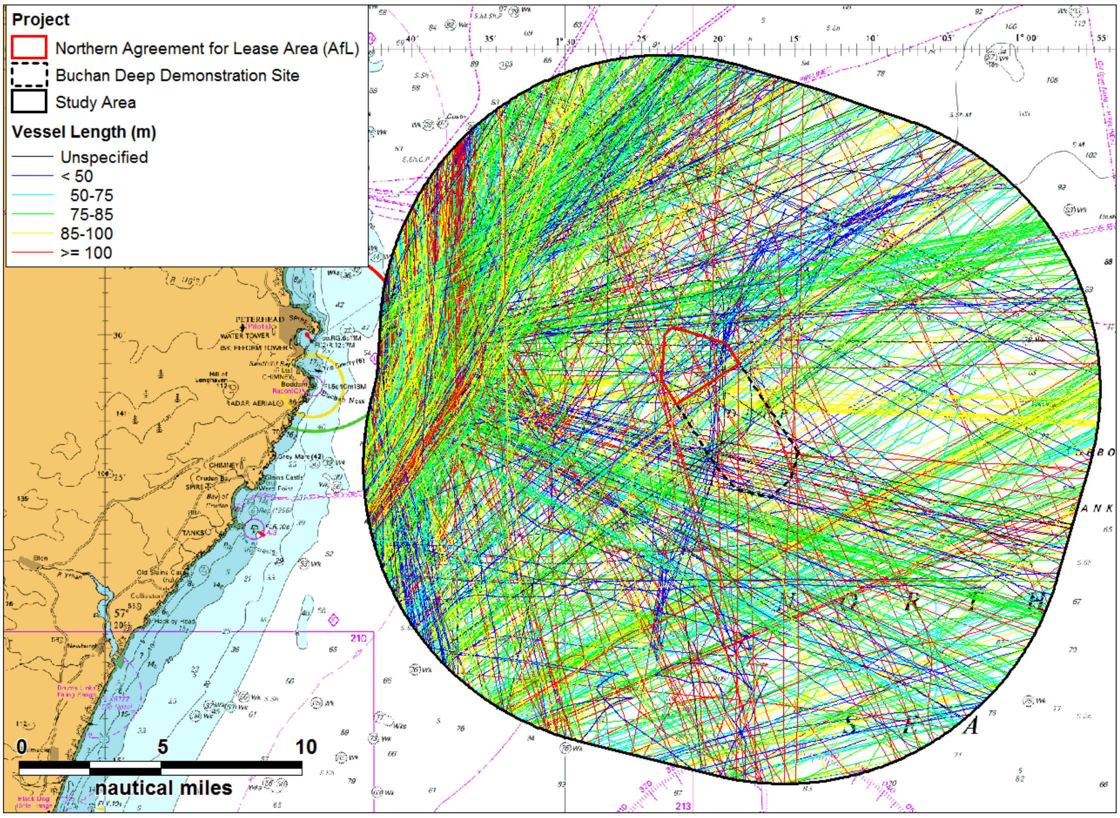


Figure 11.11 Autumn 2013 AIS Data (28 Days) by Length

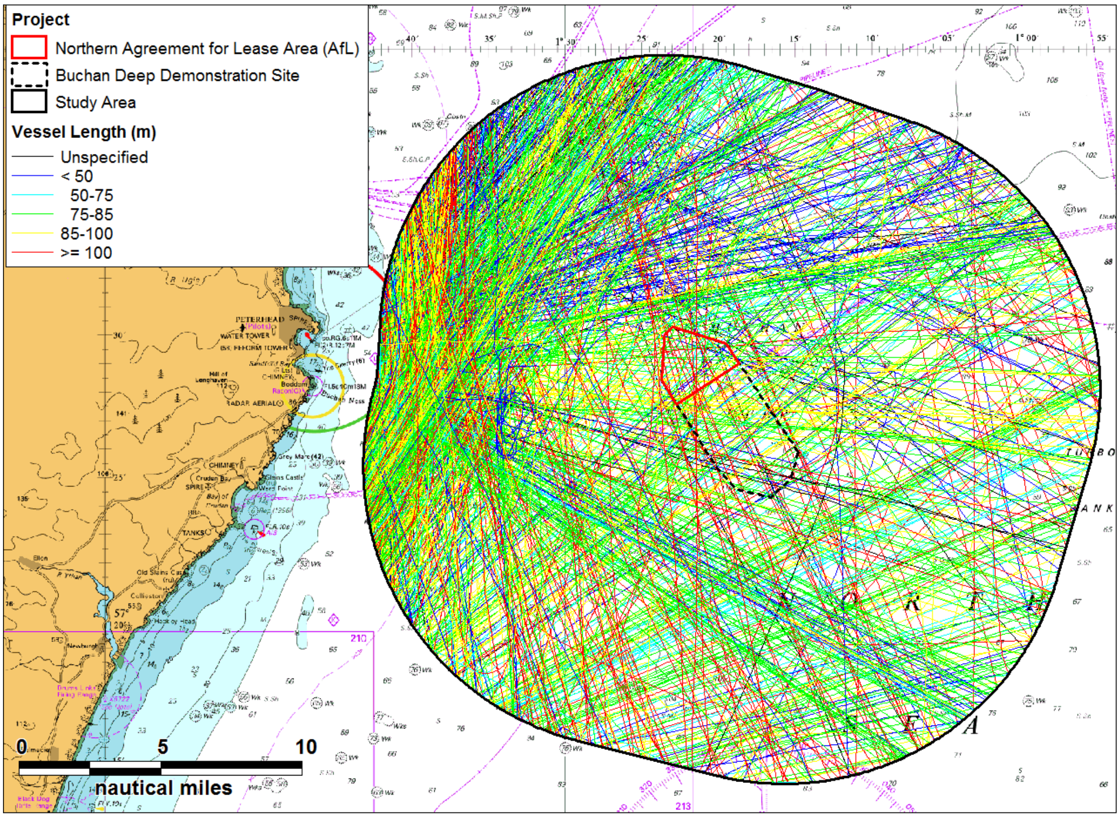


Figure 11.12 Winter 2014 AIS Data (28 Days) by Length

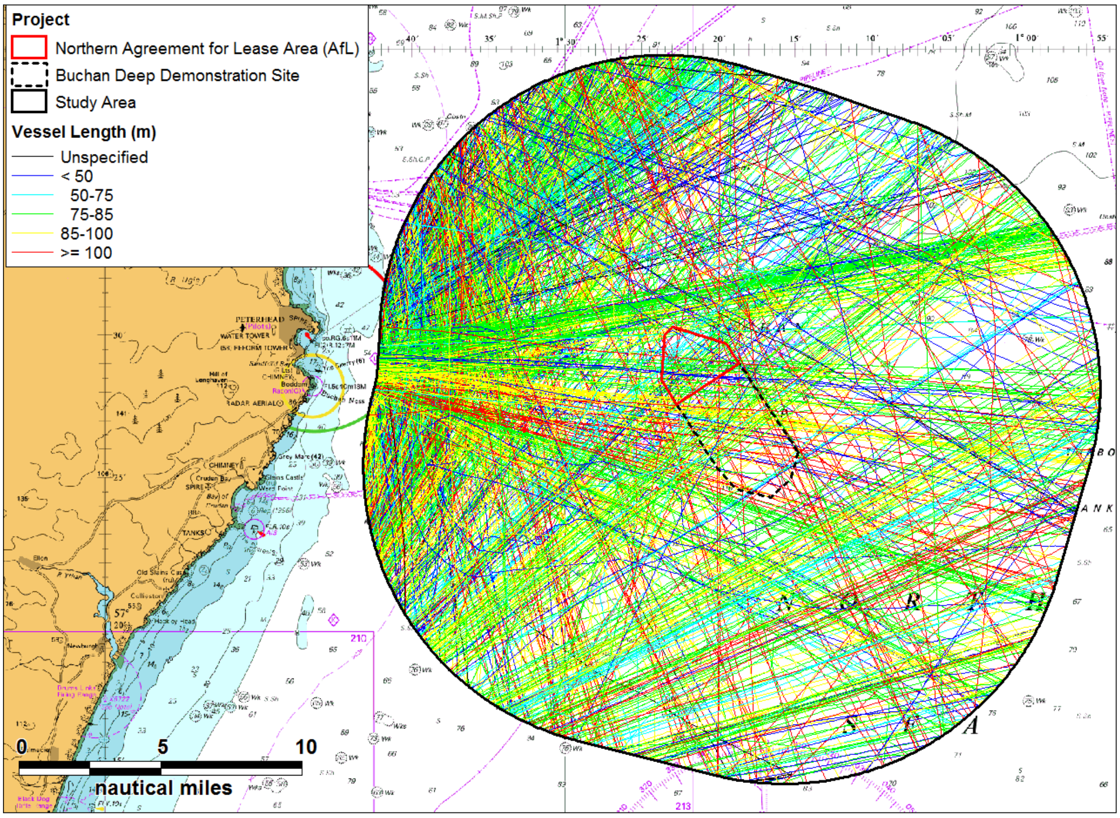


Figure 11.13 Spring 2014 AIS Data (28 Days) by Length

Figure 11.14 presents the length distribution of vessels (excluding unspecified) within the Pilot Park Study Area over the combined 16 weeks survey period.

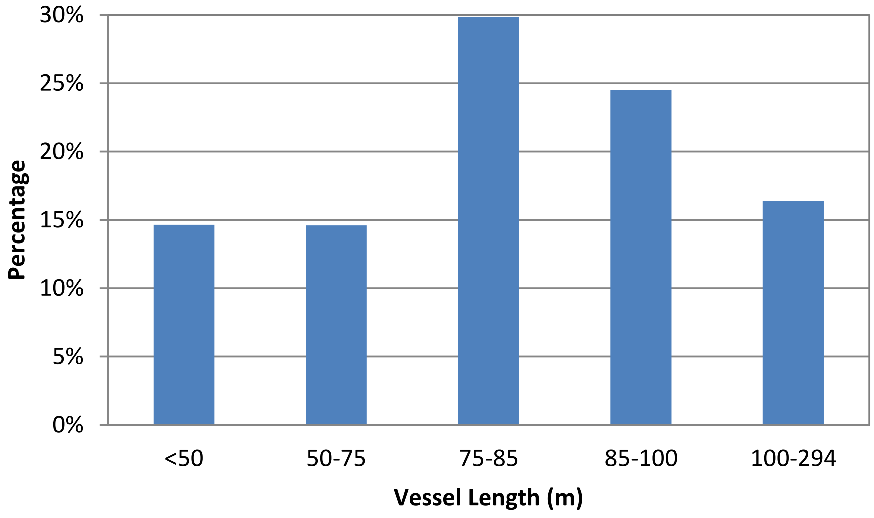


Figure 11.14 Vessel Length Distribution (16 weeks)

Just over half the vessels ranged from 75m to 100m which is a common size for offshore support vessels. The average length of vessel was 83m (excluding vessels which did not specify a length, which were mainly fishing vessels).

The five longest vessels tracked within the Pilot Park Study Area were all 294m long. Passenger cruise vessel *Brilliance of the Seas* transited southeast through the Pilot Park Study Area en route to Harwich on 6 August 2013. *Duesseldorf Express* was tracked on 8 February 2014 and *Dallas Express* on 26 April 2014, both container ships travelling northwest through the Pilot Park Study Area en route to Halifax, Canada. *Mol Excellence*, a container ship, transited northwest through the Pilot Park Study Area on 9 February 2014 while travelling to New York. Passenger cruise vessel *Queen Elizabeth* was tracked transiting north through the Pilot Park Study Area on her way to Invergordon on 3 August 2013.

11.2.5 Relative Vessel Density within Pilot Park Study Area

Figure 11.15 presents the relative vessel density within the Pilot Park Study Area, based on the combined 16 weeks AIS data.

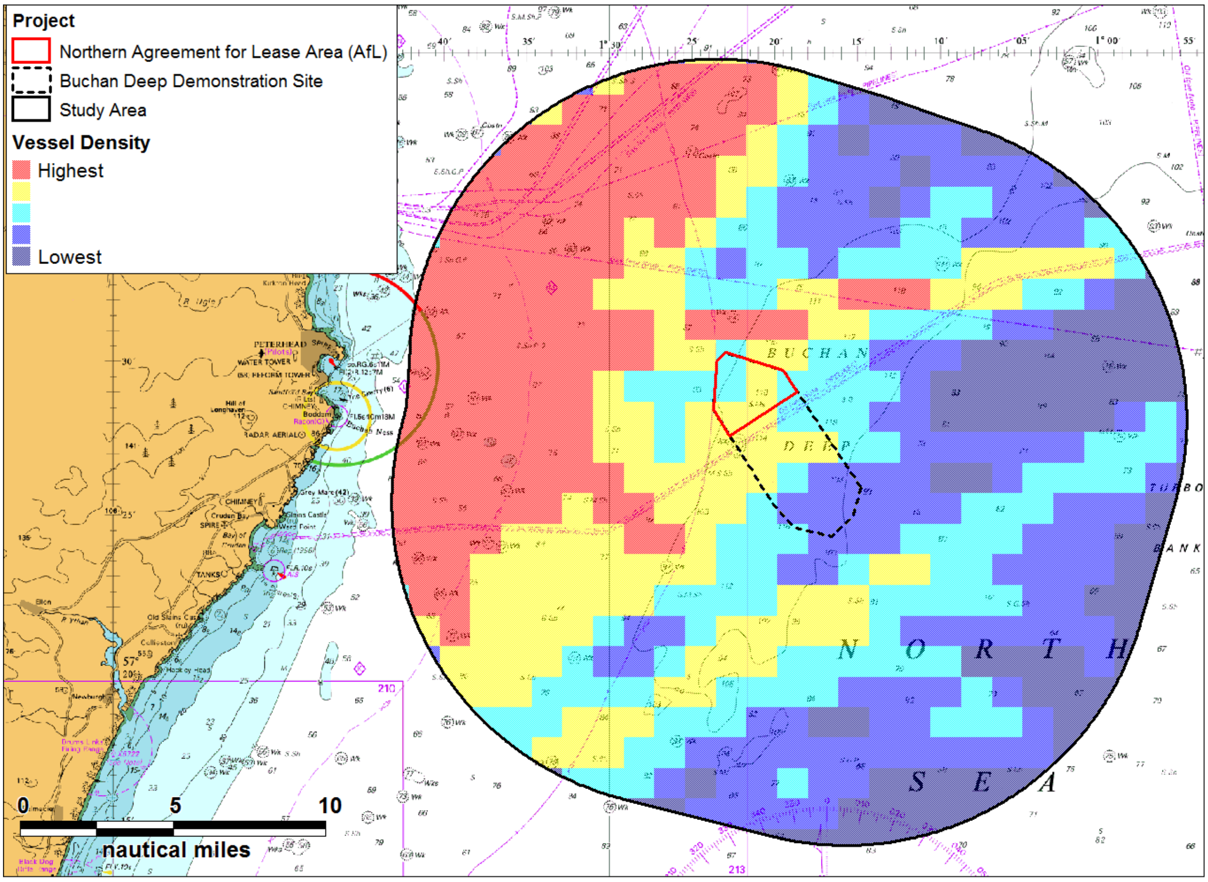


Figure 11.15 Vessel Density within Pilot Park Study Area (16 weeks)

This illustrates that the Northern AfL area has moderate vessel traffic levels relative to the wider Pilot Park Study Area. High levels of traffic to the west and northwest of the Pilot Park Study Area are associated with traffic bound to / from busy ports such as Aberdeen and Peterhead, and traffic passing north and south off the east coast of Scotland.

11.2.6 Vessel Type Intersecting Northern AfL Area

Plots of the traffic intersecting the Northern AfL area during each of the four 28 day periods, thematically mapped by type, are presented in Figure 11.16 to Figure 11.19.

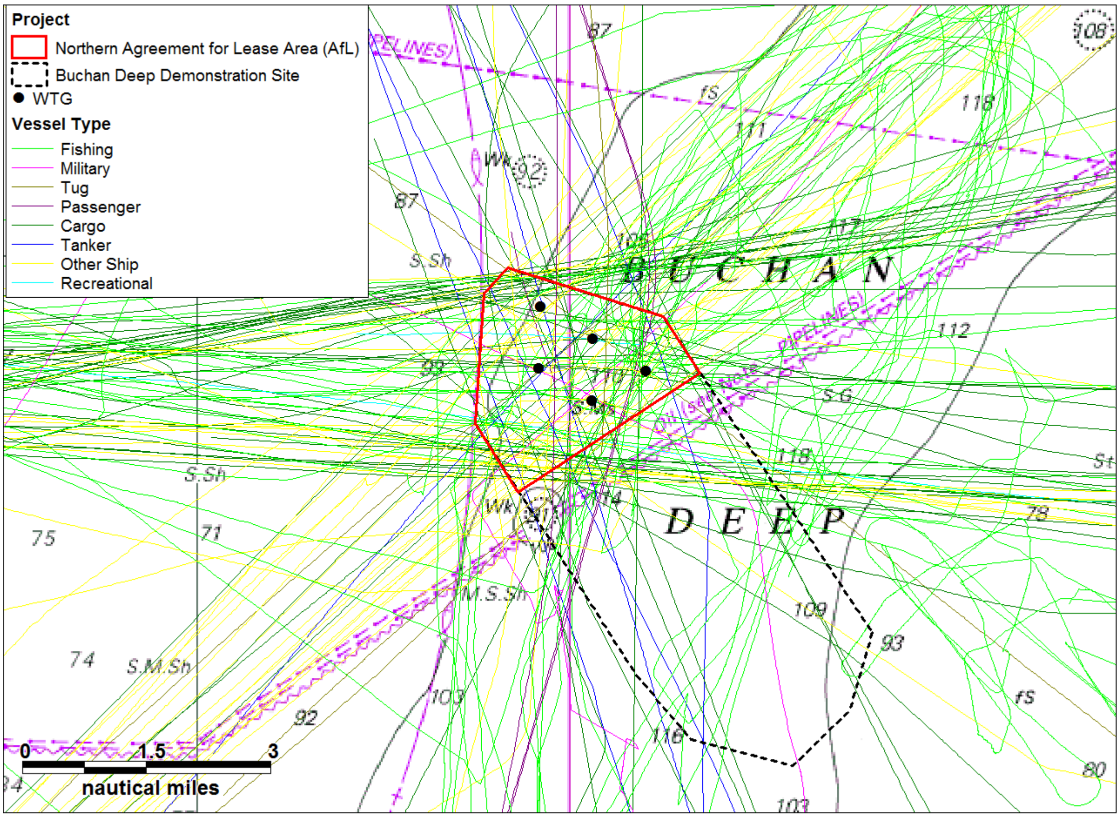


Figure 11.16 Summer 2013 AIS Data (28 Days) intersecting Northern AfL Area

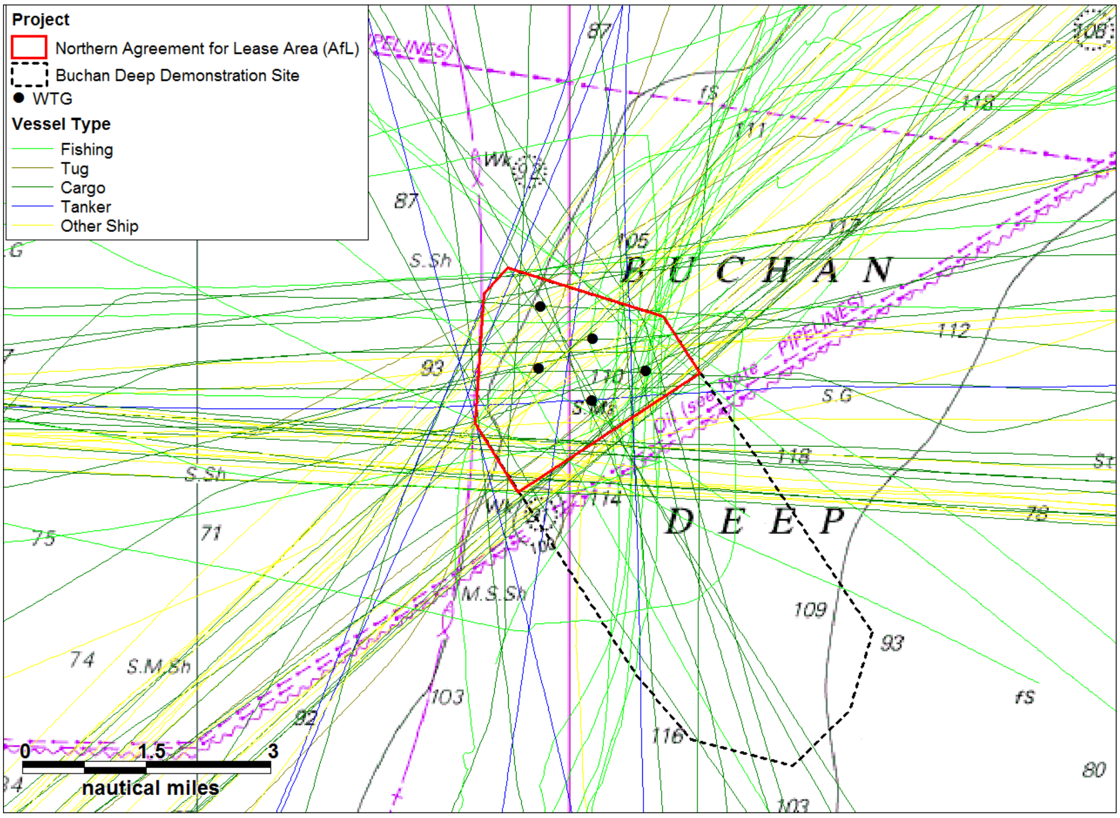


Figure 11.17 Autumn 2013 AIS Data (28 Days) intersecting Northern AfL Area

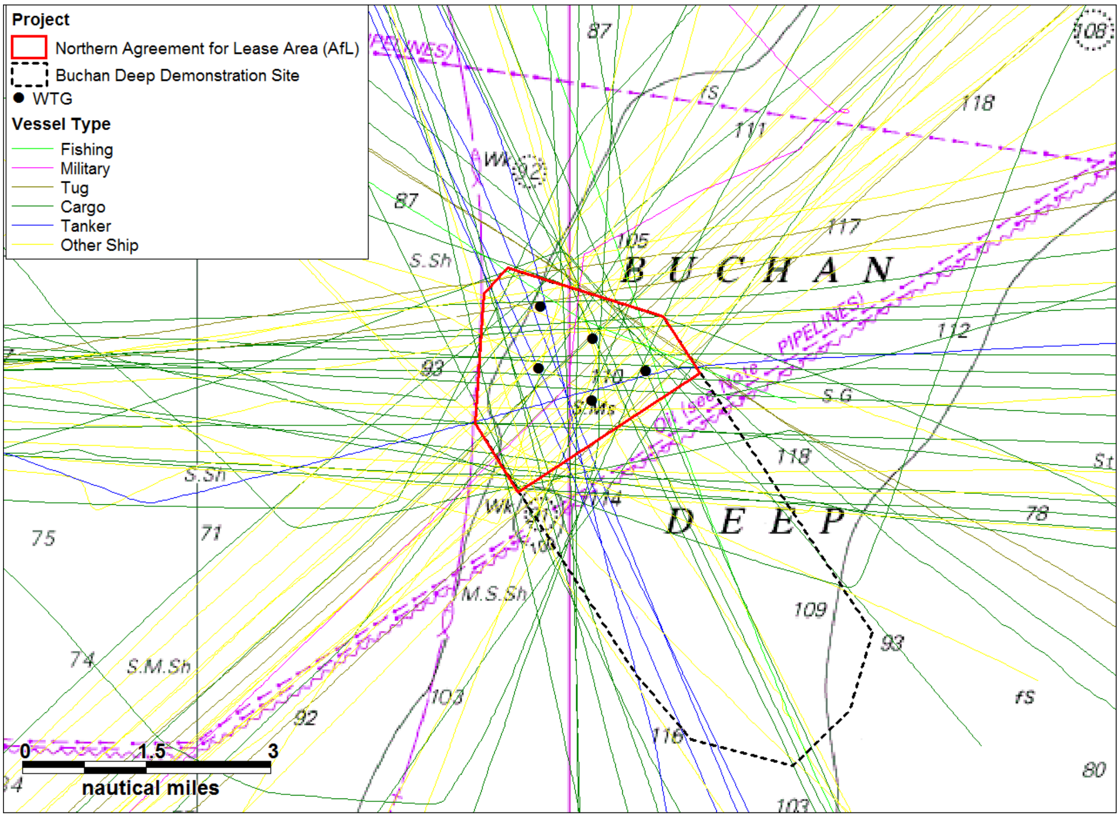


Figure 11.18 Winter 2014 AIS Data (28 Days) intersecting Northern AfL Area

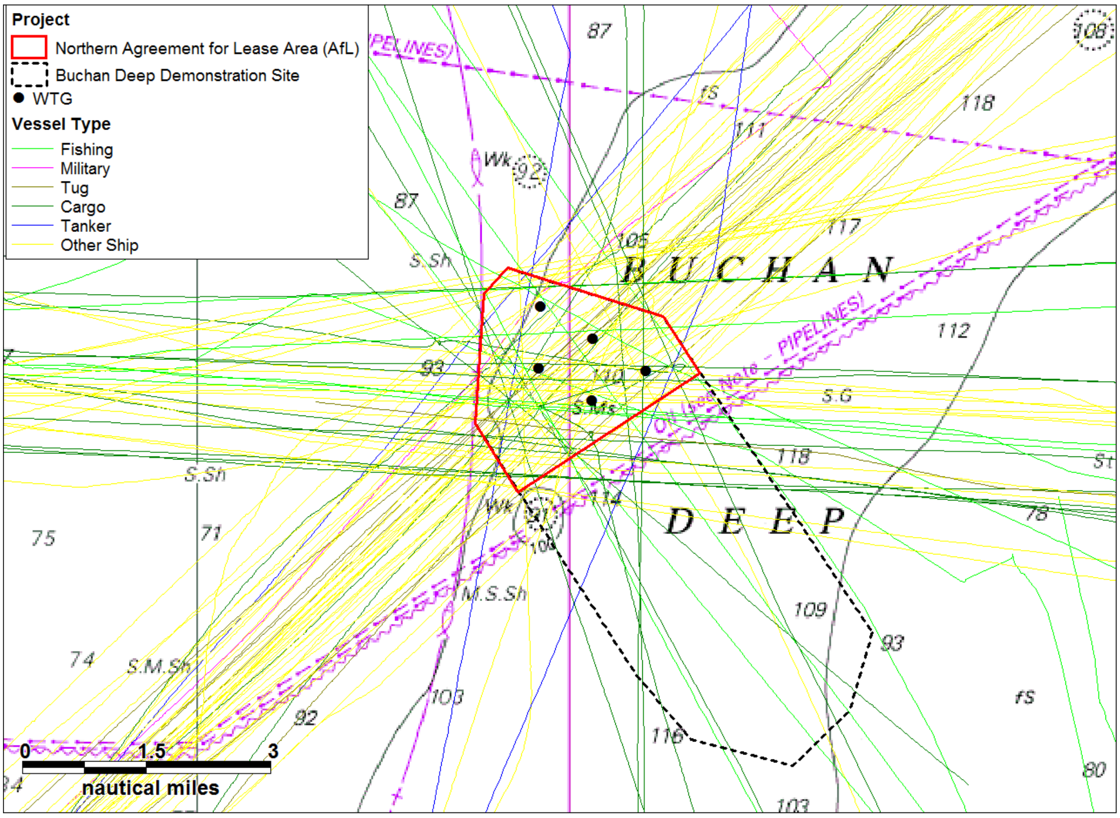


Figure 11.19 Spring 2014 AIS Data (28 Days) intersecting Northern AfL Area

The average number of unique vessels per day intersecting the Northern AfL area in each of the four survey periods is presented in Figure 11.20, with Figure 11.21 displaying the vessel type distribution over the four periods.

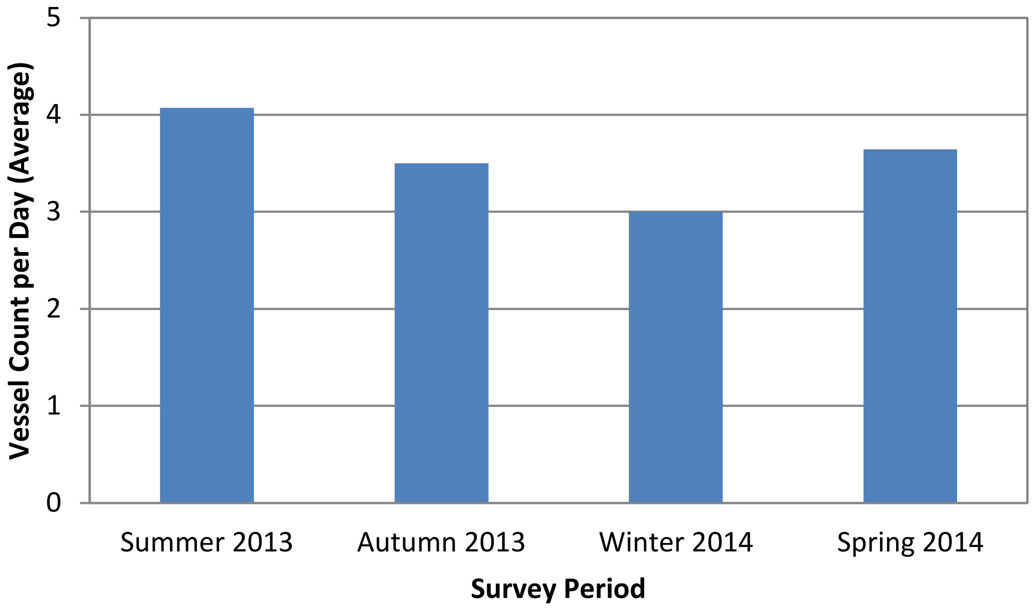


Figure 11.20 Average Daily Vessel Count intersecting Northern AfL Area

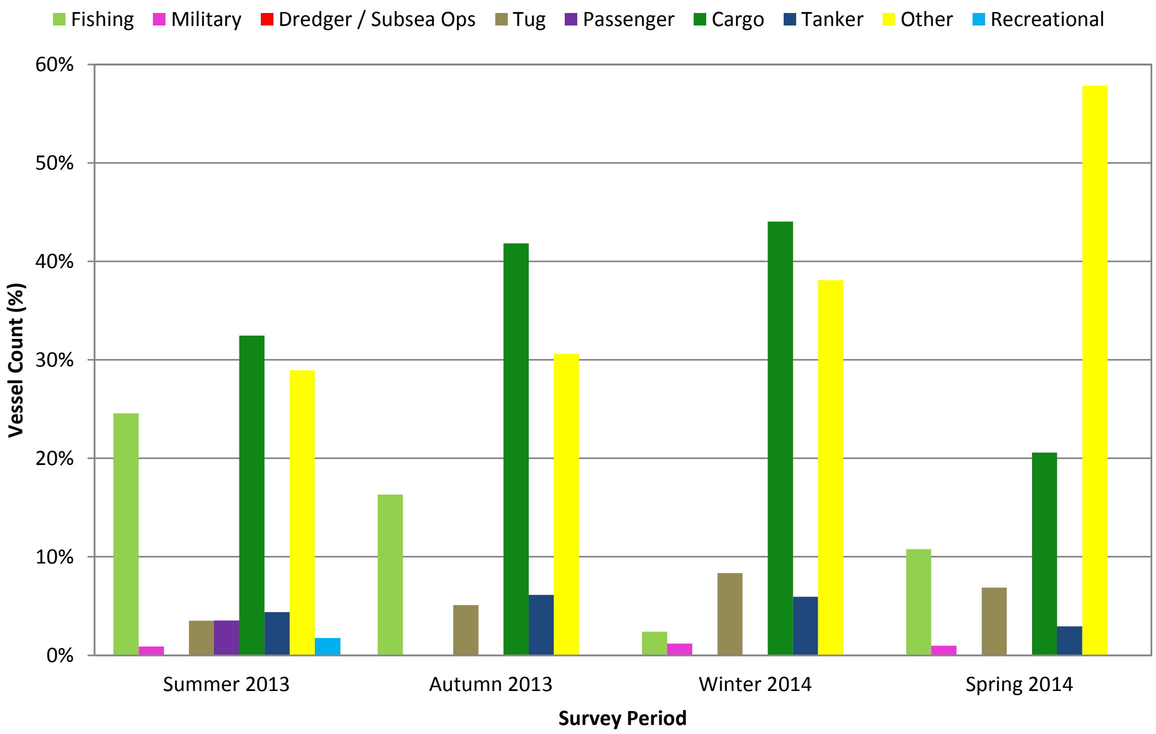


Figure 11.21 Vessel Types identified intersecting Northern AfL Area

There was an average of 3-4 unique vessels per day intersecting the Northern AfL area over the four survey periods. The maximum number of vessels per day ranged from 7-11. The vessel type distribution did not very significantly over the four periods, however there were fewer fishing vessels in winter 2014 and more 'other' vessels in spring 2014 than in the other periods. The vast majority of 'other' vessels were offshore industry vessels.

11.2.7 Vessel Type (with Offshore Category) Intersecting Northern AfL Area

A plot of the AIS tracks for the most recent spring 2004 period thematically mapped by vessel type with offshore vessels separated into a discrete category, is presented in Figure 11.22.

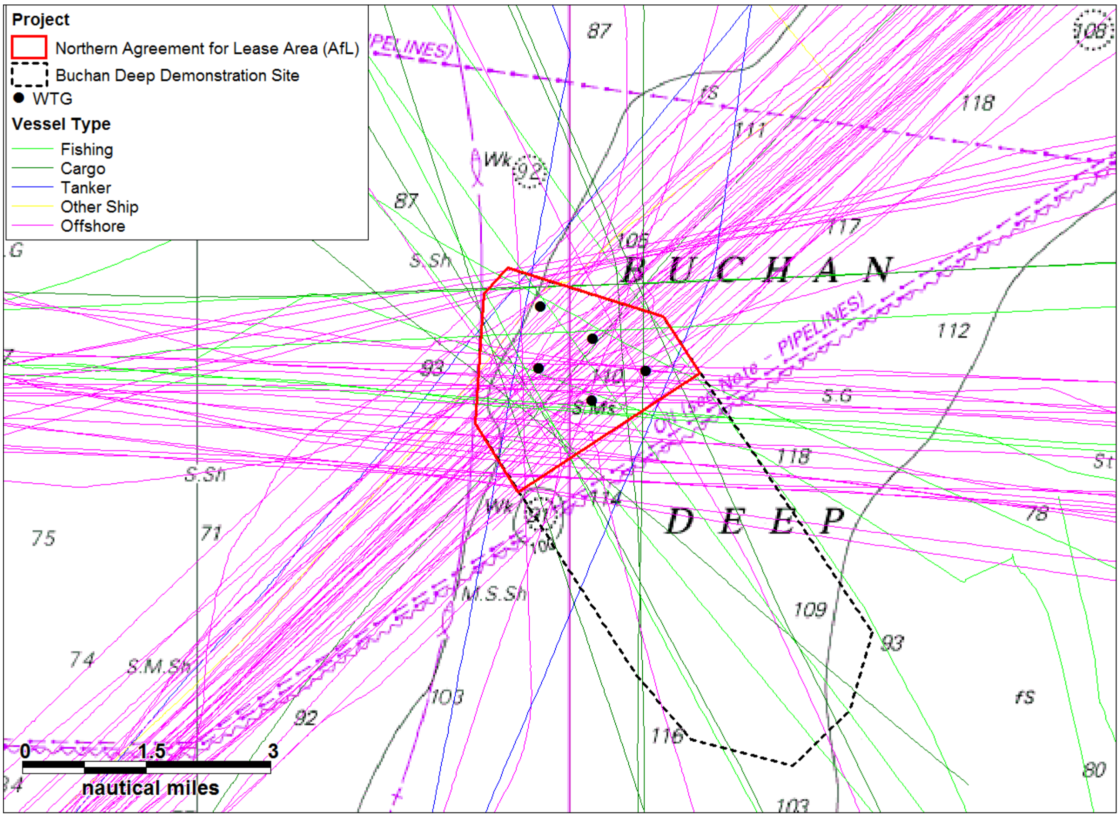


Figure 11.22 Spring 2014 AIS Data (28 Days) intersecting Northern AfL Area

Figure 11.23 displays the vessel type distribution intersecting the Northern AfL area, with offshore vessels separated into a discrete category, over the four periods.

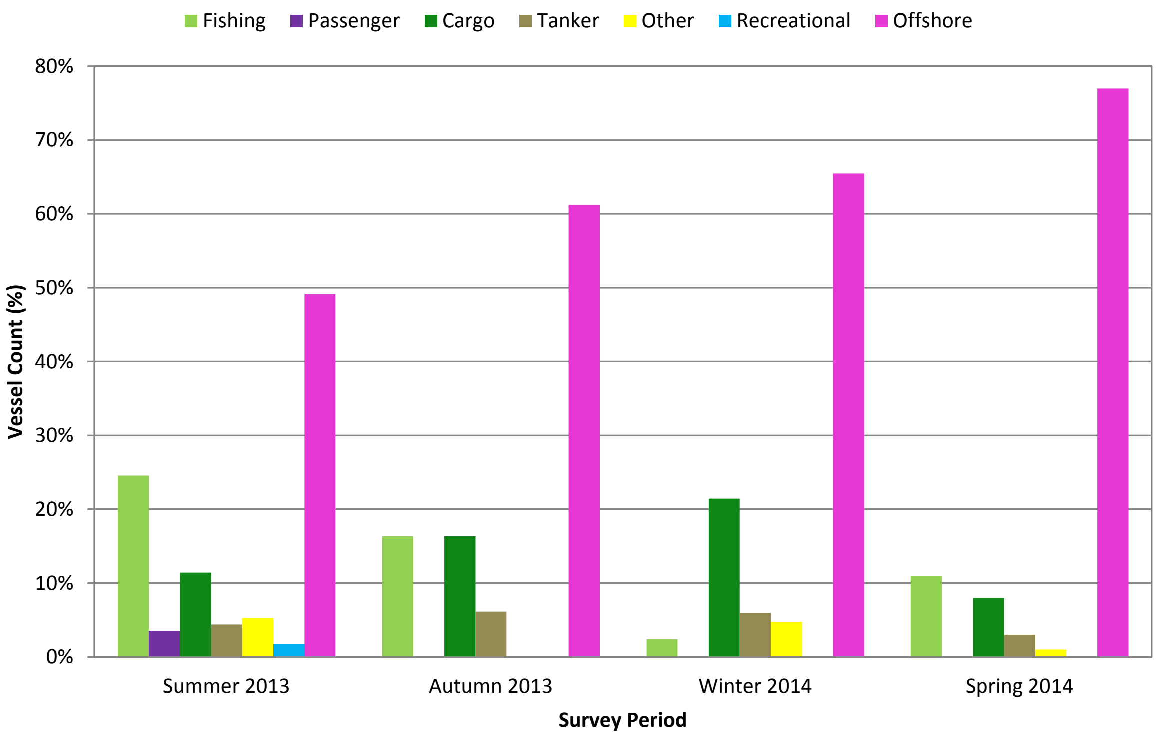


Figure 11.23 Vessel Types identified intersecting Northern AfL Area

11.2.8 Vessel Length and Draught Intersecting Northern AfL Area

A plot of the 16 weeks combined AIS data, thematically mapped by vessel length, is presented in Figure 11.24. A number of vessels which were broadcasting no length information have been researched in literature and updated.

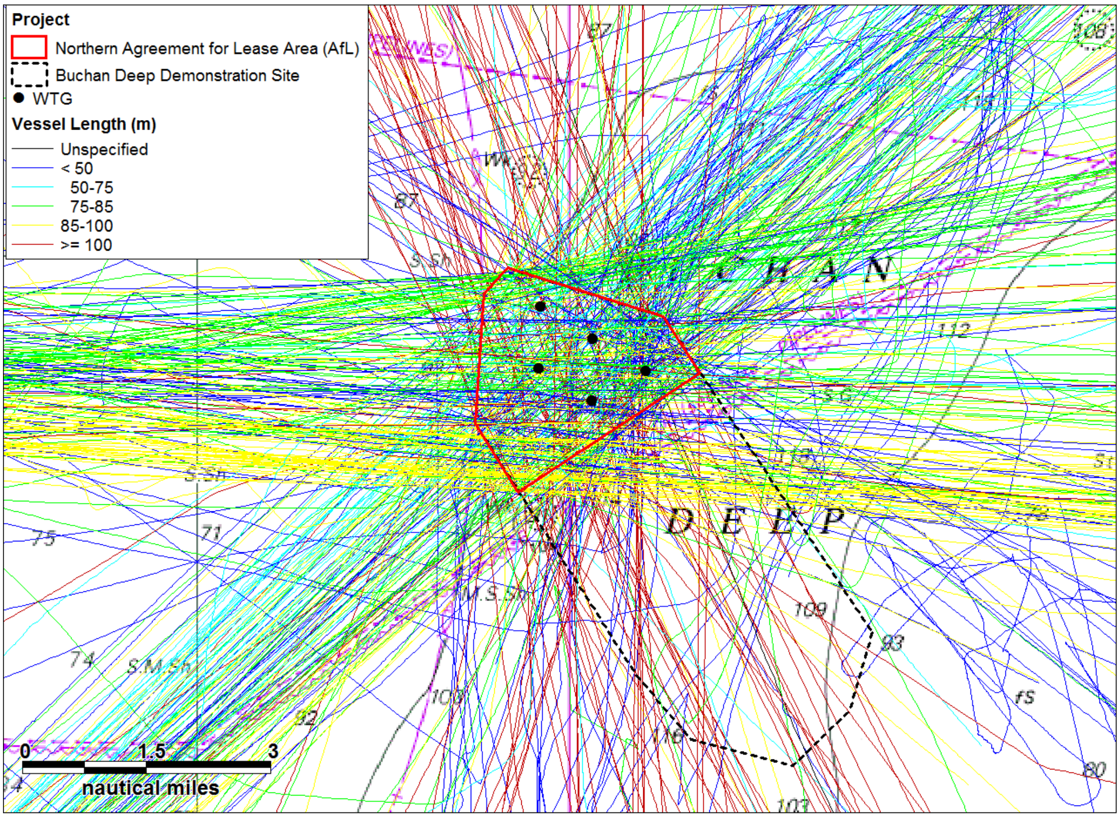


Figure 11.24 Combined AIS Data (16 weeks) intersecting Northern AfL Area by Length

The average length of vessel (excluding unspecified) was 85m. The longest vessel transiting the Northern AfL area was the 294m long container vessel, *Duesseldorf Express*, en route to Halifax, Canada, on 8 February 2014.

Figure 11.25 presents the length distribution of vessels (excluding unspecified) intersecting the Northern AfL area over the combined 112 day survey period.

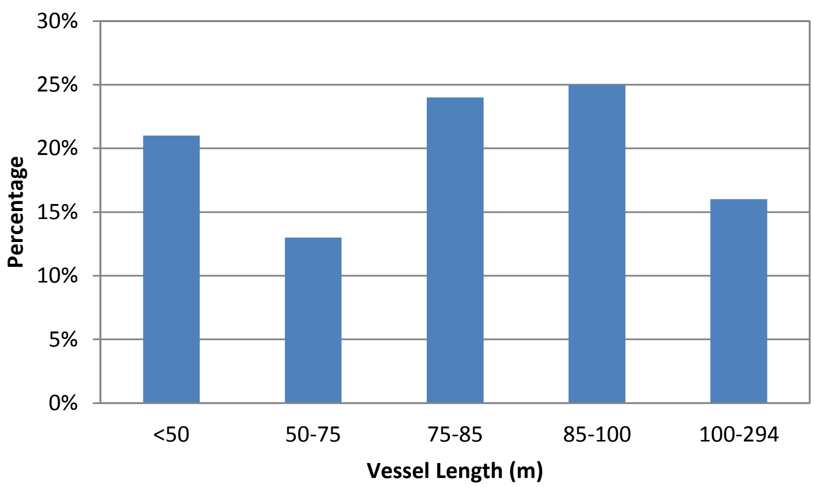


Figure 11.25 Vessel Length Distribution (16 weeks)

The average vessel draught (excluding unspecified) was 5.6m. The deepest draught vessel transiting Northern AfL area was the 17.1m draught bulk carrier, *Australia Maru*, en route to Teesport on 22 November 2013.

Figure 11.26 presents the draught distribution of vessels (excluding unspecified) intersecting the Northern AfL area over the combined 112 day survey period.

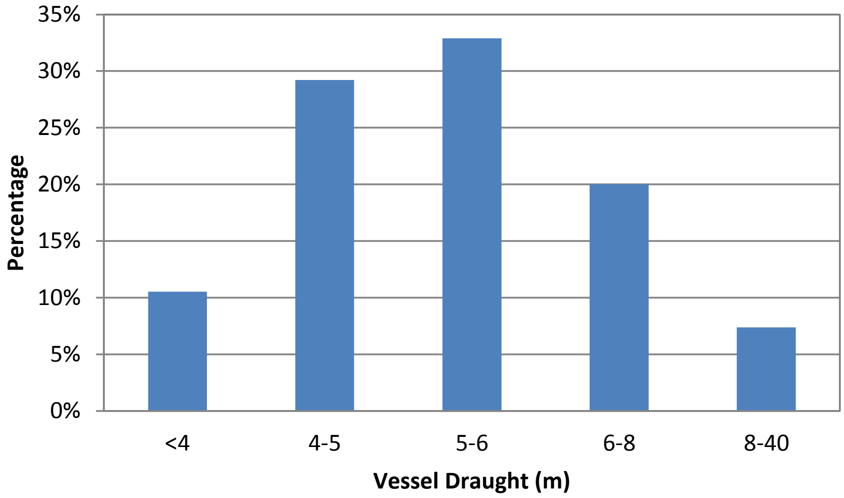


Figure 11.26 Vessel Draught Distribution (16 weeks)

11.2.9 Course, Destination and Speed Intersecting Northern AfL Area

The tracks thematically mapped by average course in each period are shown in Figure 11.27.

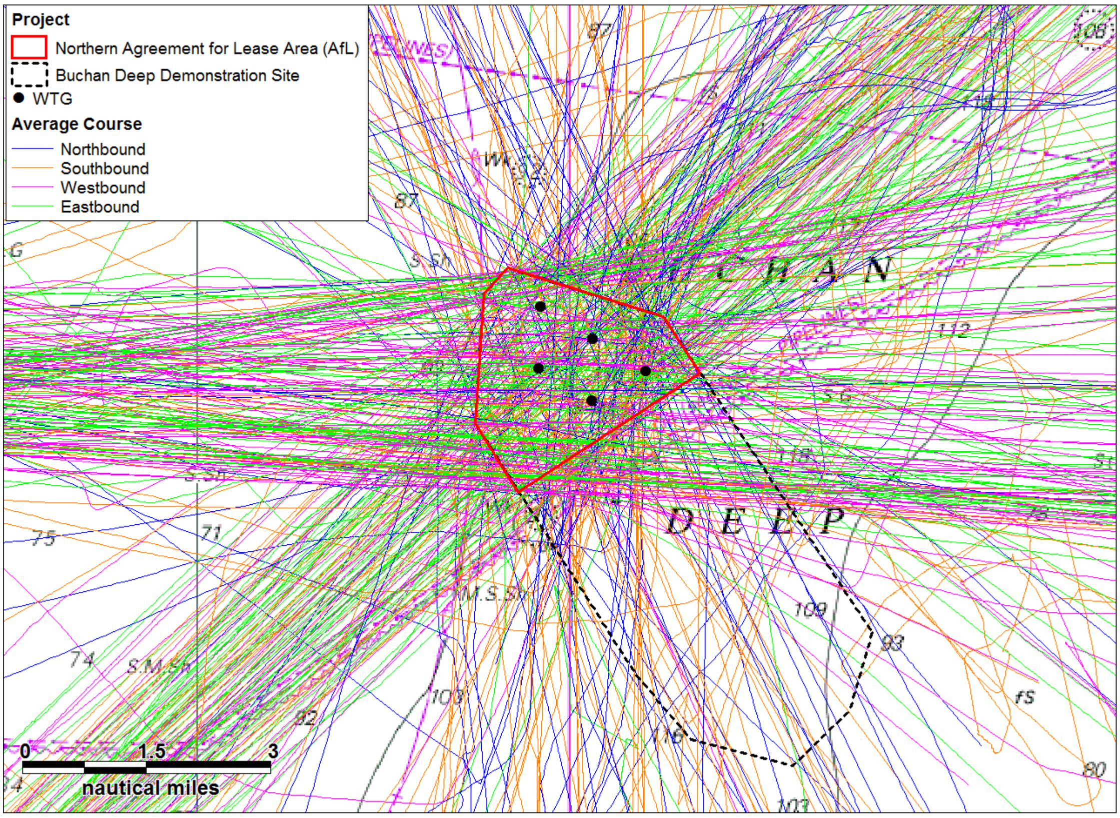


Figure 11.27 Combined AIS Data (16 weeks) intersecting Northern AfL Area by Average Course

The average courses of vessels tracked intersecting the Northern AfL area were broadly eastbound from Peterhead and Aberdeen, or westbound to Peterhead and Aberdeen. There are no TSSs or recommended routes in the vicinity of the Northern AfL area.

The main destinations broadcast by the vessels intersecting the Northern AfL area are presented in Figure 11.28.

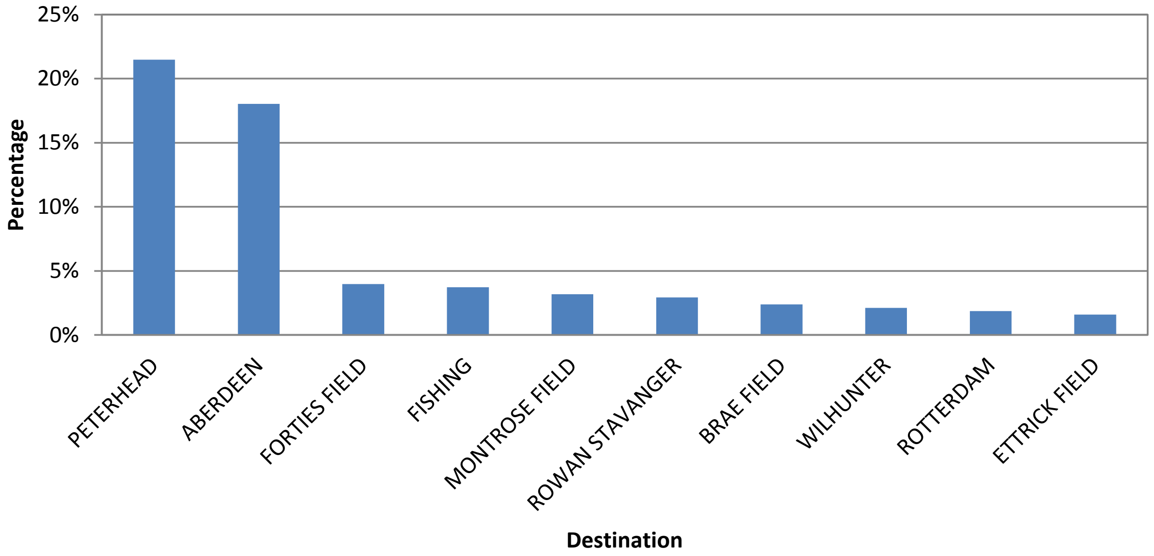


Figure 11.28 Main Destinations for Vessels intersecting Northern AfL Area (16 weeks)

The northeast Scotland ports of Peterhead (21%) and Aberdeen (18%) were the most common destinations (excluding unspecified). 'Fishing' was recorded as a destination by 4% of vessels. A number of vessels were transiting to offshore oil and gas installations in the North Sea (usually departing from Peterhead and Aberdeen). This included temporary, mobile installations such as the *Rowan Stavanger* and *Wilhunter* drilling rigs, as well as fixed, permanent installations such as the Montrose, Brae and Ettrick Fields. Ten percent of vessels did not specify a destination, the majority of which were fishing vessels.

The average speed distribution of vessels (excluding unspecified) intersecting the Northern AfL area over the combined 16 week period is presented in Figure 11.29.

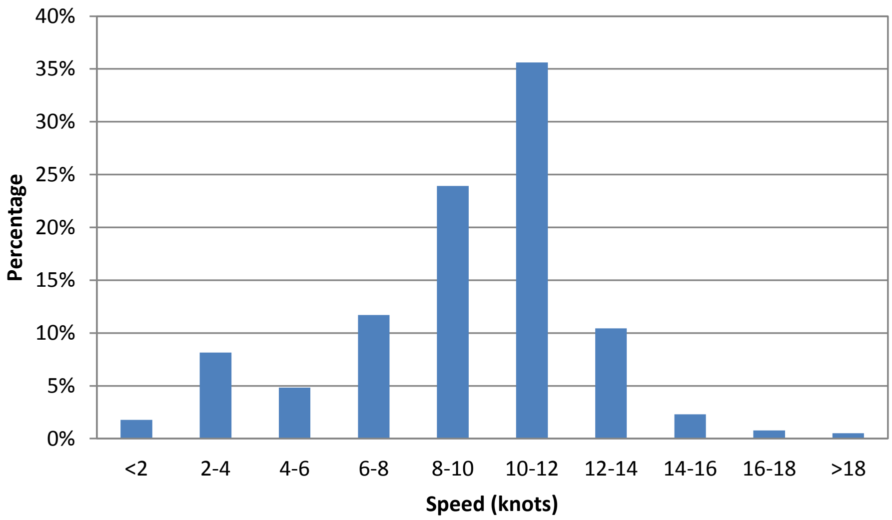


Figure 11.29 Average Speed of Vessels intersecting Northern AfL Area (16 Weeks)

The overall, average speed was 9.4 knots. The fastest vessel was *Albatross*, a passenger cruise vessel en route to Rosyth on 23 August 2013, recorded at a maximum speed of 18.5 knots.

11.2.10 Details of Vessels Intersecting Northern AfL Area

Table 11.1 presents details of vessels which were most regularly tracked intersecting the Northern AfL area (on four or more occasions) over the 16 weeks combined survey period.

Table 11.1 Details of Vessels Intersecting Northern AfL Area (16 Weeks)

Name	Type	Number of Transits	Length (m)	Destination
Vestland Mira	Offshore Supply	38	86	Montrose Field / Rowan Stavanger / Peterhead
Highland Vanguard	Offshore Supply	15	81	Wilhunter / Aberdeen
FS Taurus	Pipe Carrier	13	82	Forties Field / Peterhead
VOS Don	Offshore Supply	12	51	Aoka Mizu / Ettrick Field / Aberdeen
Grampian Courageous	Safety Vessel	7	47	Brae Field / Aberdeen
Grampian Protector	Safety Vessel	7	39	Brae Field / Piper / Aberdeen
Grampian Sceptre	Offshore Supply	7	83	Sedco 711 / Arbroath Field/ Peterhead
Blue Fighter	Offshore Supply	6	84	Forties Field / Peterhead
Caledonian Vision	Offshore Supply	6	93	Bruce Field / Aberdeen
Grampian Sovereign	Offshore Supply	6	83	Montrose Field / Aberdeen
VOS Victory	Standby Safety	6	55	Scott Field / Aberdeen
Undisclosed	Fishing	5	19	--
Margaretha	General Cargo	4	145	Reyðarfjörður / Rotterdam
Undisclosed	Fishing	4	30	Fishing Grounds / Peterhead
Solvik Supplier	Offshore Supply	4	85	Sedco 711 / Peterhead
Undisclosed	Fishing	4	42	--

Name	Type	Number of Transits	Length (m)	Destination
Uta	General Cargo	4	145	Hull / Rotterdam
Undisclosed	Fishing	4	24	Peterhead
Yeoman Bontrup	Bulk Carrier	4	250	Glensanda / Amsterdam

The majority of these vessels were associated with the offshore industry, being either offshore supply vessels or ERRV (standby safety vessels).

The most common vessel passing through the Northern AfL area over the 16 week period was the *Vestland Mira* offshore supply vessel, which transited between Peterhead and the *Rowan Stavanger* jack-up rig or Montrose Field. This vessel was present in all four survey periods.

11.2.11 Anchored Vessels

Figure 11.30 presents the anchoring activities in the area during the 16 weeks of AIS survey data. Details for each of the anchored vessels can be found in Table 11.2.

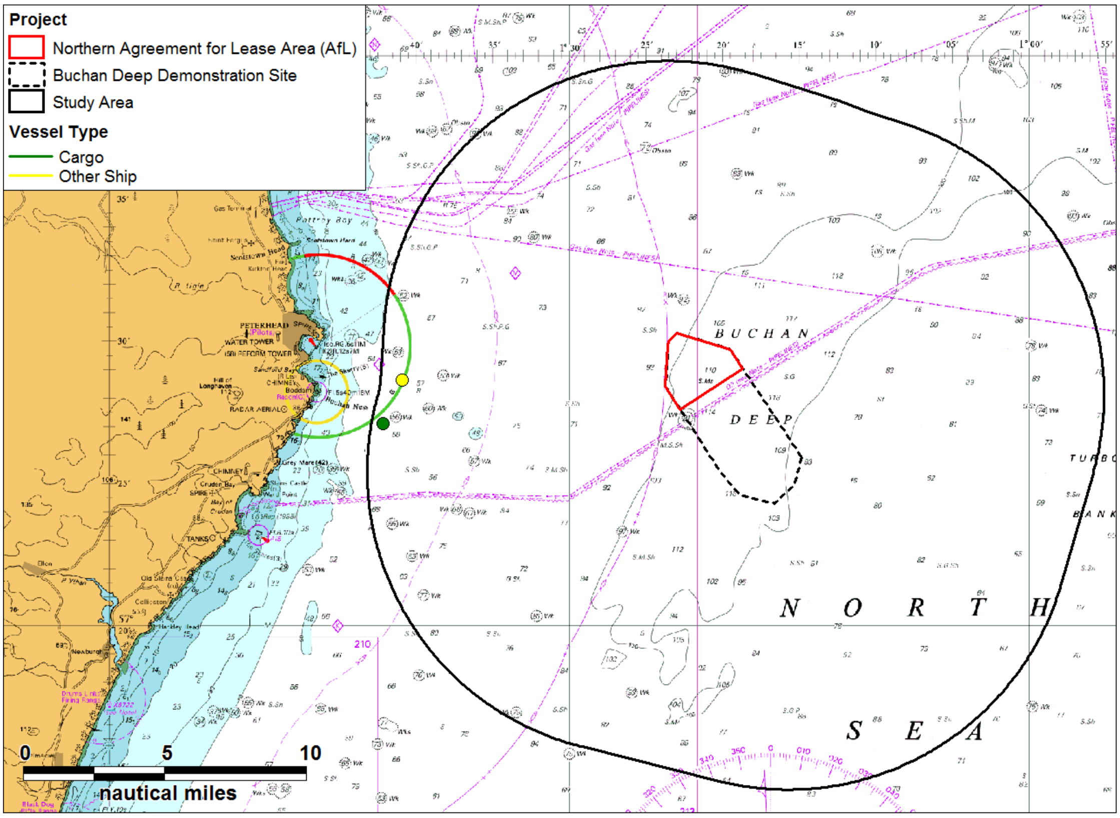


Figure 11.30 Anchored Vessel Survey Tracks within Pilot Park Study Area (16 Weeks AIS)

Table 11.2 Anchored Vessel Details (16 weeks)

Name	Type	Length (m)	Draught (m)	DWT (Tons)	Duration (hours / minutes)
Amiko	General Cargo	100	4.4	4695	31 h 22 min
Blue Fighter	Offshore Supply	84	5.2	4242	2 h 34 min

The total duration of anchoring was approximately 34 hours, contributed by two vessels.

11.3 Visual Observations

11.3.1 ESAS Bird Survey

Vessel traffic data were also recorded as part of the ESAS bird survey work undertaken from June 2013 to April 2014 at the Hywind Scotland Pilot Park Project, to provide supplementary data on vessel activity. Visual observations of targets were recorded by surveyors onboard the *Eileen May* survey vessel. Survey diaries were used to manually log any vessels observed over the duration of the bird survey.

Surveys undertaken on 17 days between June 2013 and April 2014 have been included in this assessment. A total of 133 hours was spent surveying in the vicinity, approximately eight hours per day. Surveys were never undertaken when the sea state was above 5 (rough), which is the limit for ESAS surveying.

Figure 11.31 presents the number of vessels tracked each day during the bird surveys, with a breakdown by vessel type.

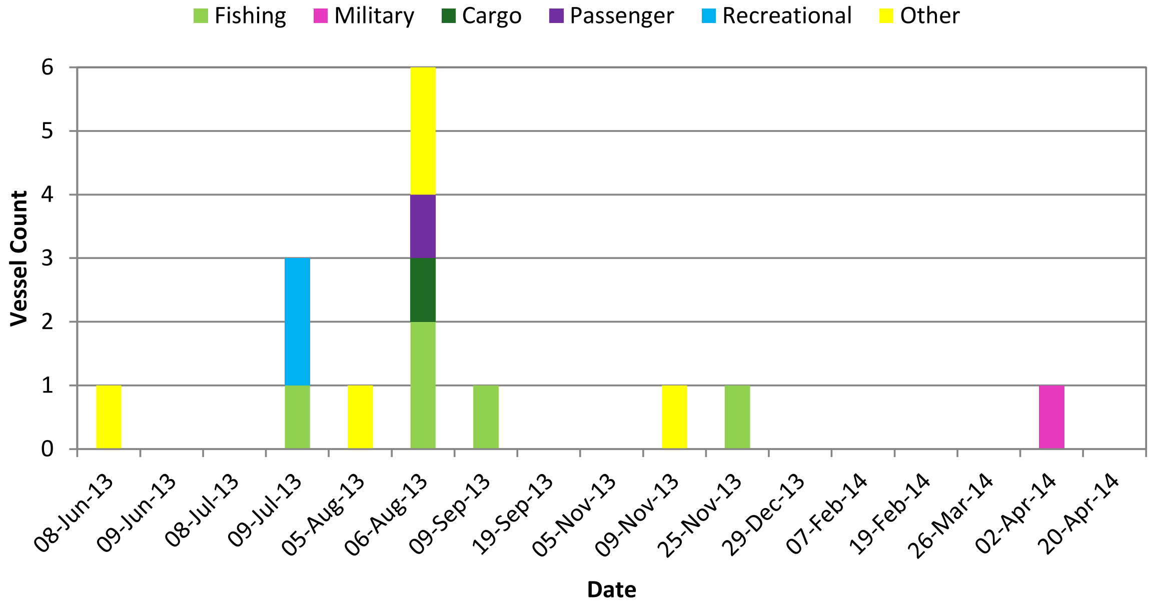


Figure 11.31 Vessel Types per day Tracked in vicinity of the Hywind Scotland Pilot Park Project during Bird Surveys

A total of 15 vessels were tracked over the survey period, five trawlers, one military, one bulk carrier cargo, one passenger cruise liner, two yachts and five ‘other’ vessels. Four of the ‘other’ type vessels tracked were offshore supply / support vessels, and one was a survey vessel.

It is likely that the majority of these vessels would have been broadcasting on AIS. Smaller fishing vessels and recreational vessels may not have been broadcasting on AIS, but this is not recorded within the logs.

11.3.2 Geophysical Survey

A manual traffic survey was carried out from 6 to 28 August 2013, using visual observations of radar targets recorded on paper log sheets by the *Franklin* survey vessel during a geophysical survey. The objective was to record sightings of all vessels (including non-AIS, such as fishing and recreational craft). In addition to the position of the sighting, information on type and size was recorded.

Figure 11.32 presents the daily vessel count during the survey, with Figure 11.33 displaying an overview of the vessels recorded, thematically mapped by vessel type. (It should be noted that this figure displays a previous site boundary for the Project).

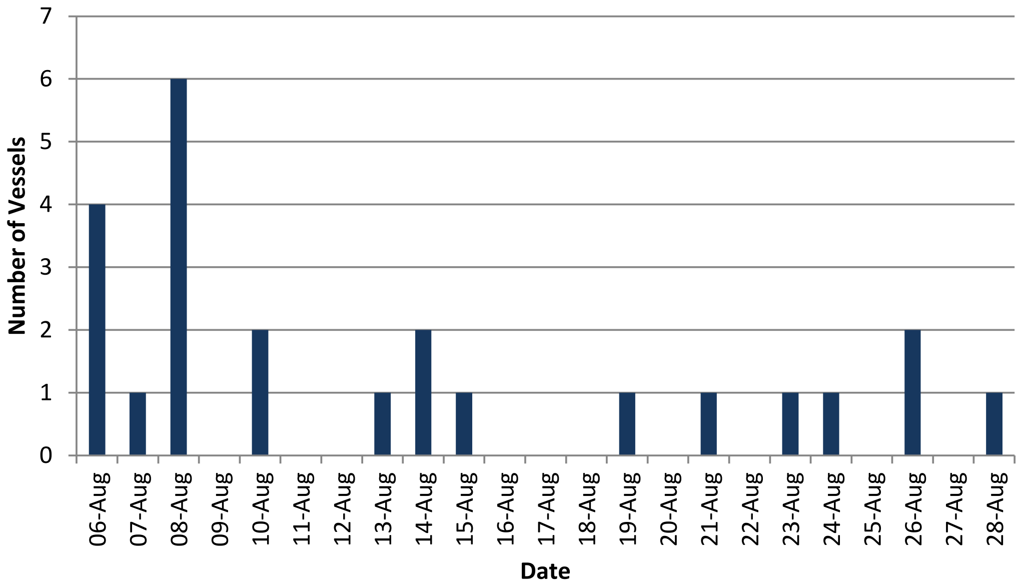


Figure 11.32 Vessel Count Tracked in Vicinity of the Hywind Scotland Pilot Park Project during Geophysical Survey

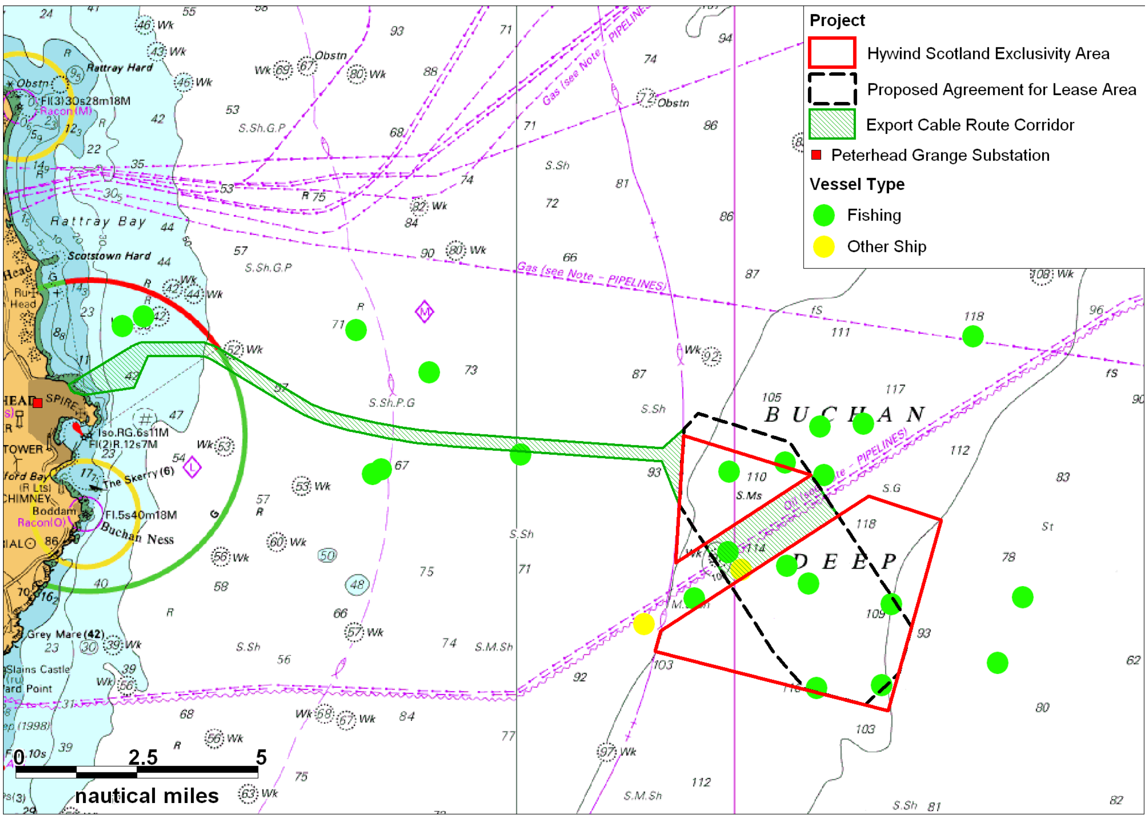


Figure 11.33 Vessel Type Tracked in Vicinity of the Hywind Scotland Pilot Park Project during Geophysical Survey

A total of 23 vessel sightings were recorded in proximity to the Hywind Scotland Pilot Park Project. The most common vessel type was fishing vessel (92%). The remaining 8% were survey vessels tracked travelling to Aberdeen. The vessel observed most often was a fishing vessel travelling to and from Peterhead.

Analysis of the vessel data showed that all vessels recorded in the traffic survey log were AIS targets, indicating that the majority of vessels in the vicinity of the Hywind Scotland Pilot Park Project broadcast on AIS.

12. FISHING VESSEL ACTIVITY

12.1 Introduction

This section reviews the fishing vessel activity in the vicinity of the Pilot Park Study Area based on the maritime traffic survey and the latest available surveillance data (sightings and satellite).

Consultation with SFF indicated that long-term satellite (VMS) data and seasonal AIS would be robust for identifying fishing activity in the Buchan Deep area, which is over 12 miles offshore.

12.2 Survey Data

At the time of the 2013-14 AIS surveys, AIS carriage was mandatory for fishing vessels ≥ 18m length under EU Directive. A proportion of smaller fishing vessels also carry AIS voluntarily but may not broadcast continuously.

In addition to fishing, a number of fishing vessels were working as guard boats for the offshore industry, e.g., protecting pipelines or subsea installations. Guard vessels have been identified separately from other fishing vessels.

A plot of the combined 16 weeks AIS tracks is presented in Figure 12.1.

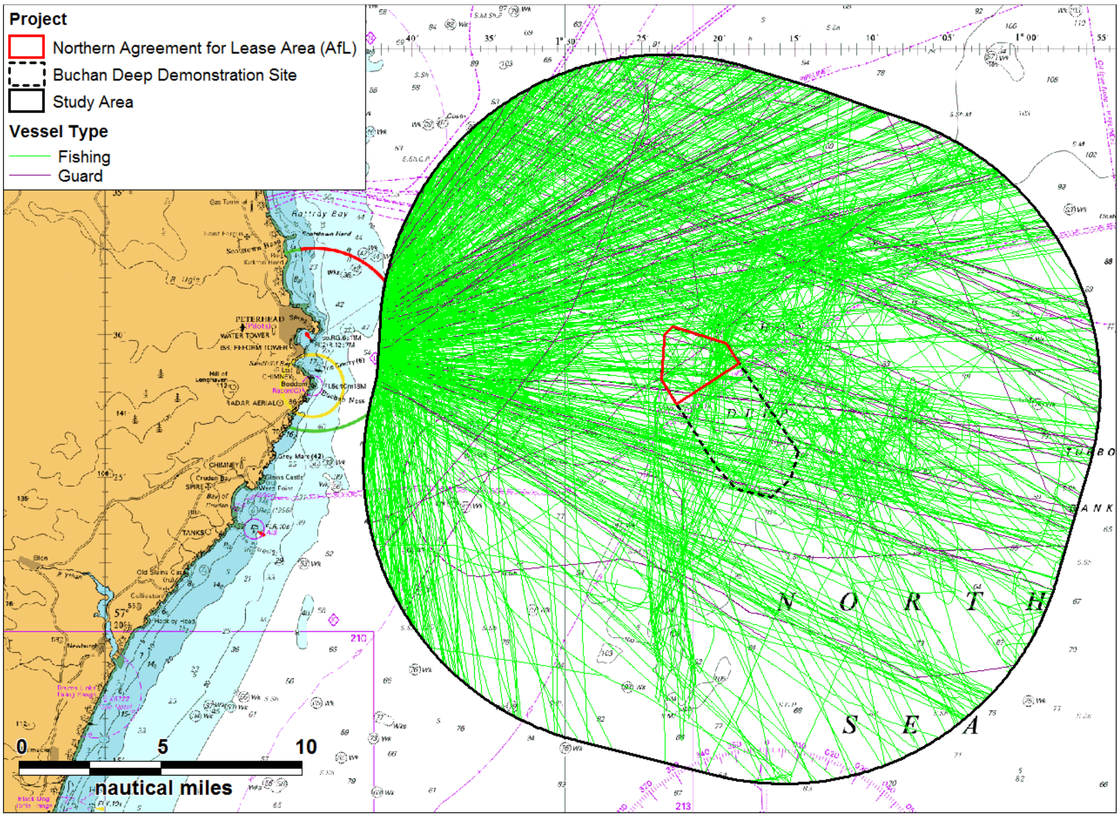


Figure 12.1 Fishing Vessel Survey Tracks within Pilot Park Study Area (16 Weeks AIS)

Overall, 892 fishing vessel tracks were recorded within the Pilot Park Study Area during the combined 16 weeks AIS survey periods, an average of eight per day. Of these, 7% were identified to be engaged in guard duties for the oil & gas industry.

An average of one fishing vessel every two days was tracked intersecting the Northern AfL area. The most common vessel to transit through the Northern AfL area was tracked on five different days, with three others each tracked on four different days. Four guard vessels intersected the Northern AfL area over the entire period.

12.3 Surveillance Data – Geographical Division

Fisheries statistics in the UK are reported by ICES statistical Rectangles and Subsquares. The Northern AfL area is located within ICES Rectangles 43E8 and 44E8, and more specifically Subsquares 43E8/2 and 44E8/4, as shown in Figure 12.2. The average Subsquare area is approximately 242nm^2 (833km^2).

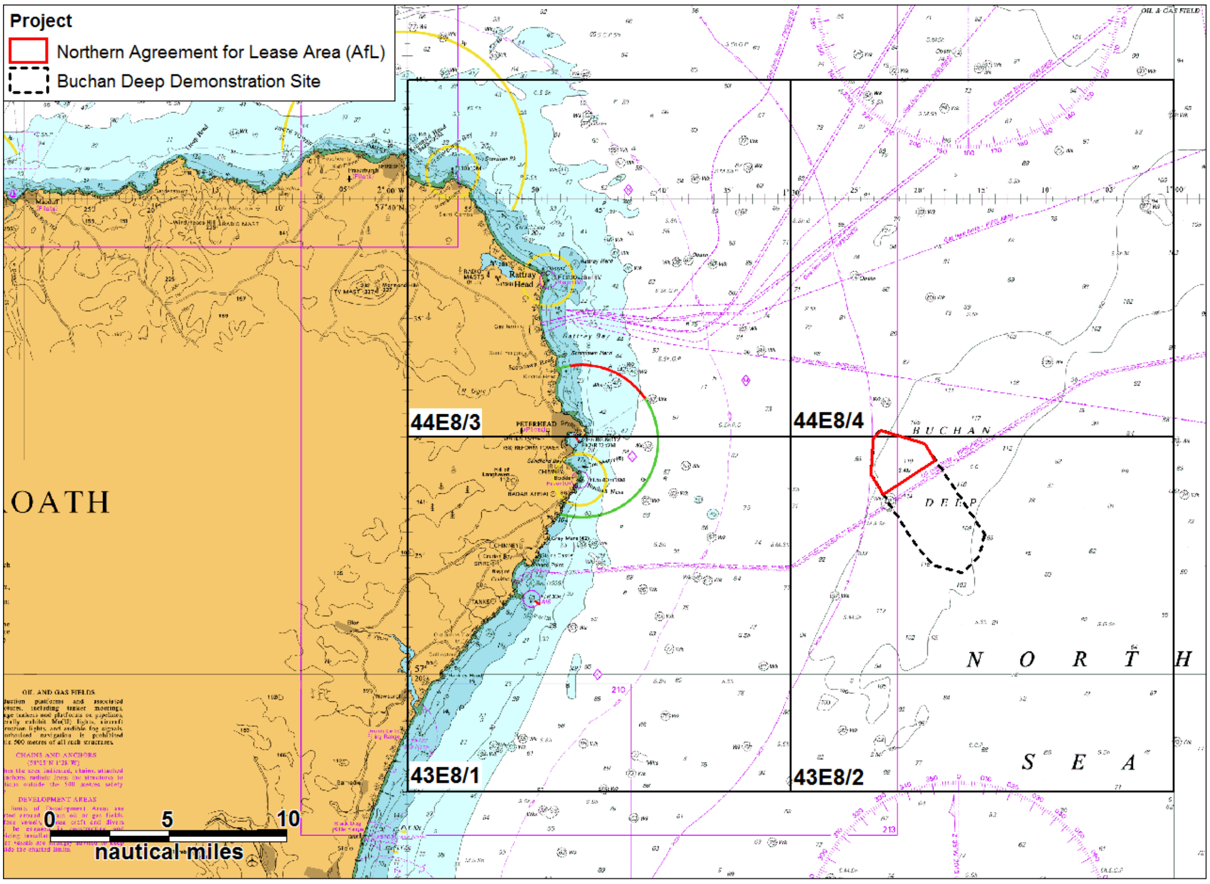


Figure 12.2 ICES Subsquares in the vicinity of the Pilot Park

12.4 Sightings Data

Data on fishing vessel sightings were obtained from Marine Scotland Compliance who monitor the fishing industry in Scottish waters through the deployment of patrol vessels and surveillance aircraft.

Each patrol logs the positions and details of fishing vessels within the Rectangle being patrolled. All vessels are logged, irrespective of size, provided they can be identified by their PLN. Records of the number of patrols are no longer available.

The sightings data from four years (2008-2012) were imported into a GIS for mapping and analysis. The fishing vessel sightings thematically mapped by nationality are presented in Figure 12.3.

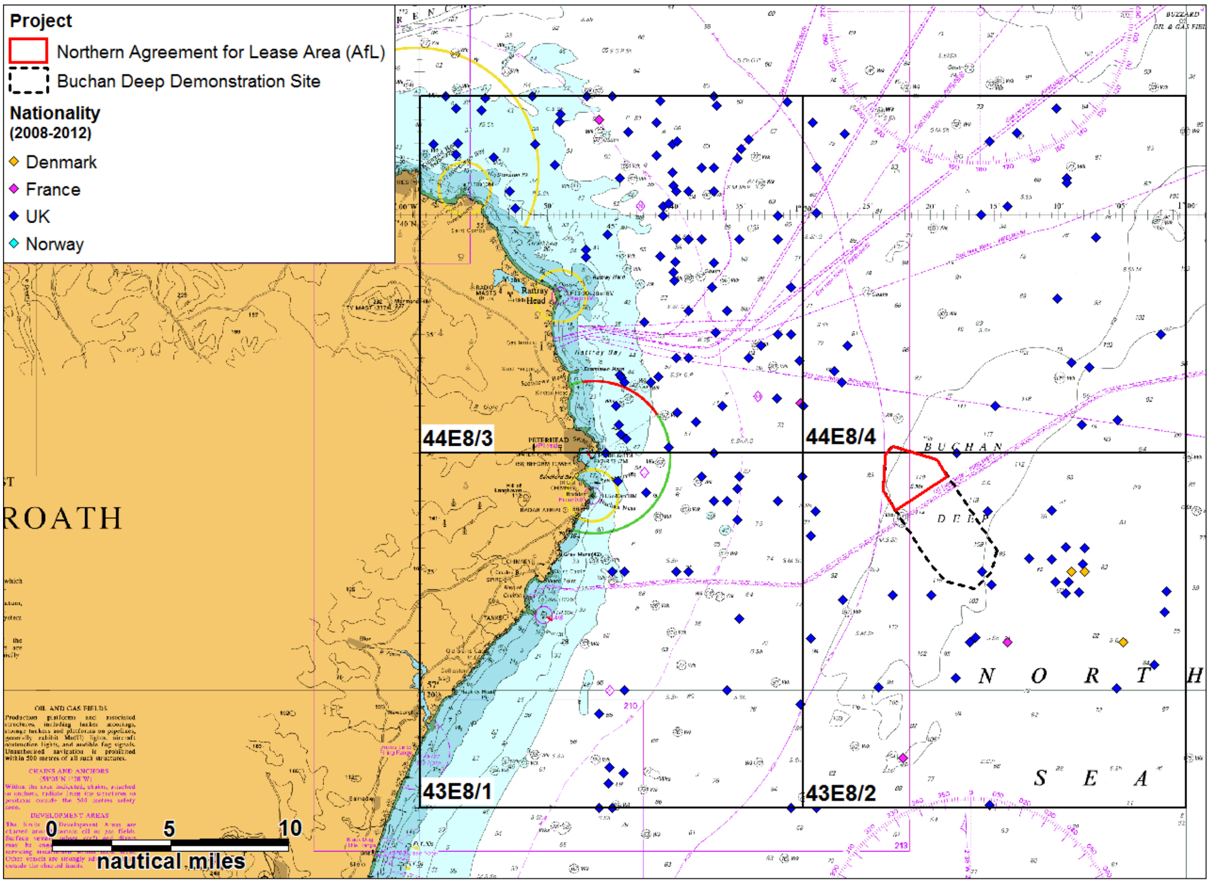


Figure 12.3 Fishing Vessel Sightings by Nationality

The majority of fishing vessels were UK-registered (95.5%). No sightings were recorded within the Northern AfL area.

The fishing vessel sightings thematically mapped by gear type are presented in Figure 12.4.

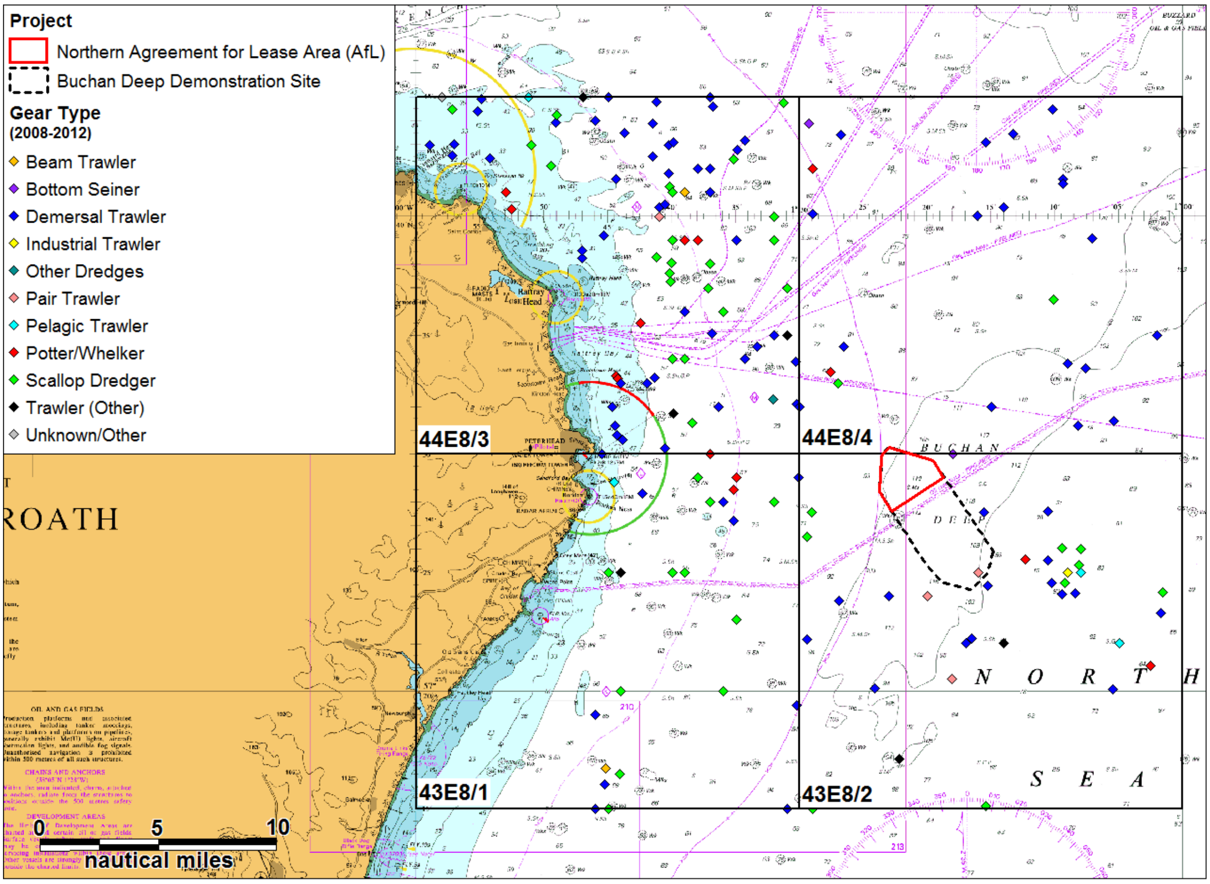


Figure 12.4 Fishing Vessel Sightings by Type

The main fishing method overall was demersal trawling, accounting for approximately 70% of activity.

Fishing vessels thematically mapped by activity when sighted are presented in Figure 12.5.

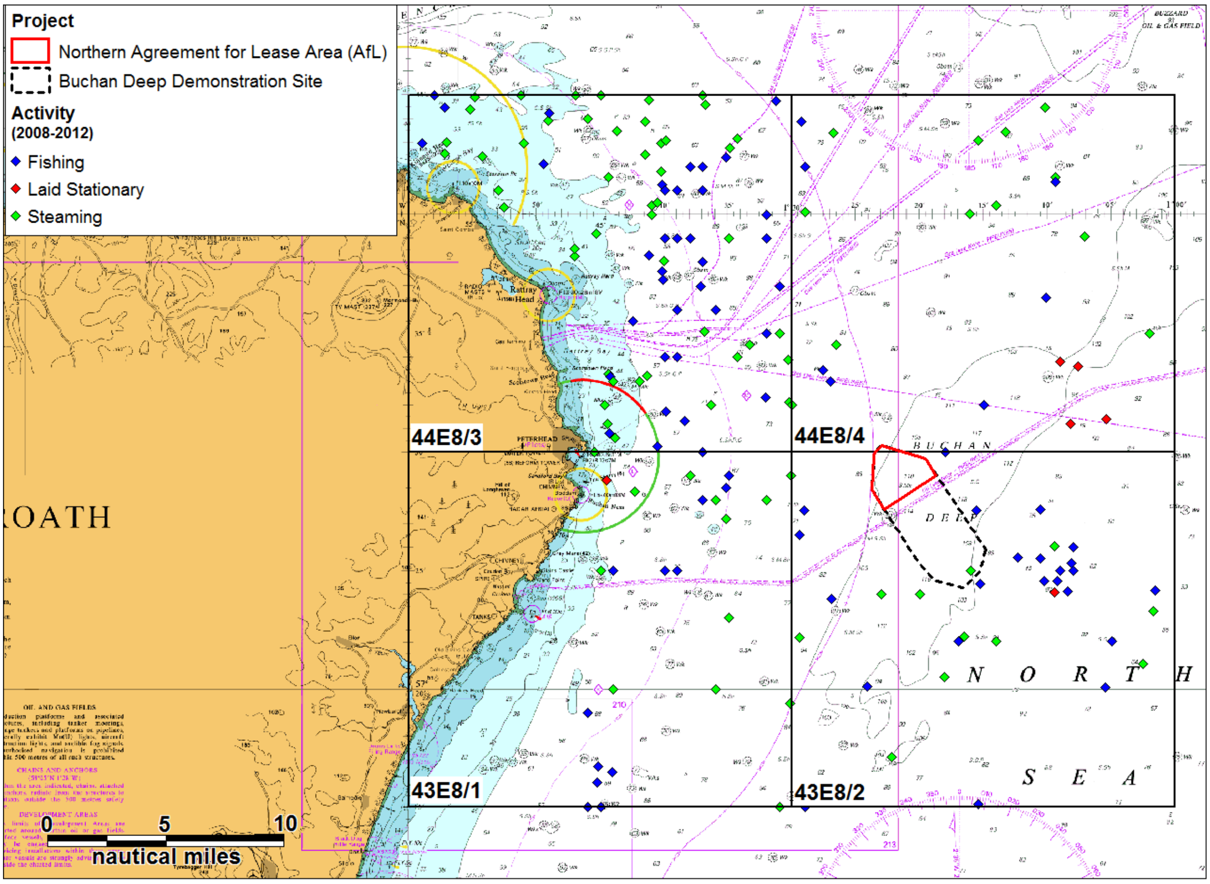


Figure 12.5 Fishing Vessel Sightings by Activity

Approximately half the vessels sighted were steaming (transiting to / from fishing grounds), and half were engaged in fishing, i.e., gear deployed.

The lengths of vessels are summarised in Figure 12.6.

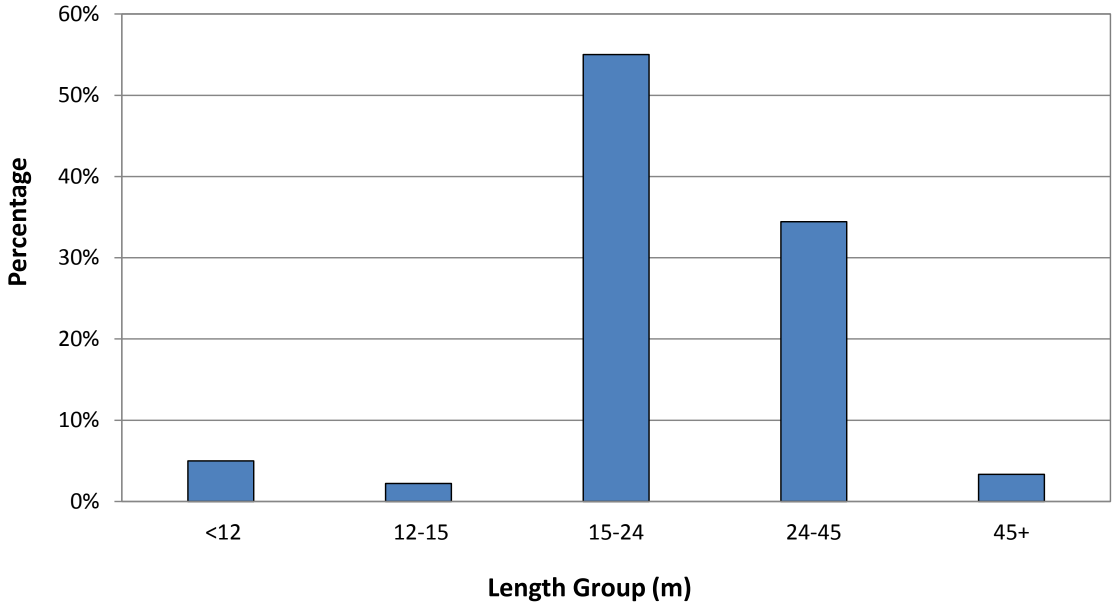


Figure 12.6 Fishing Vessel Sightings by Length Group (2008-12)

Only 7% of vessels were below 15m in length. These were mainly inshore vessels. The majority of vessels recorded in the vicinity of the Hywind Scotland Pilot Park Project were larger vessels of 15m length and over.

12.5 Satellite Data

The MMO operates a satellite-based vessel monitoring system. The vessel monitoring system is used, as part of the sea fisheries enforcement programme, to track the positions of fishing vessels of 15m length and over in UK waters. It is also used to track all UK registered fishing vessels globally.

Vessel position reports are typically received every two hours. 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 data for 2011-2012, which includes both UK and non-UK vessels, is presented in Figure 12.7 and Figure 12.8, thematically mapped by nationality and speed.

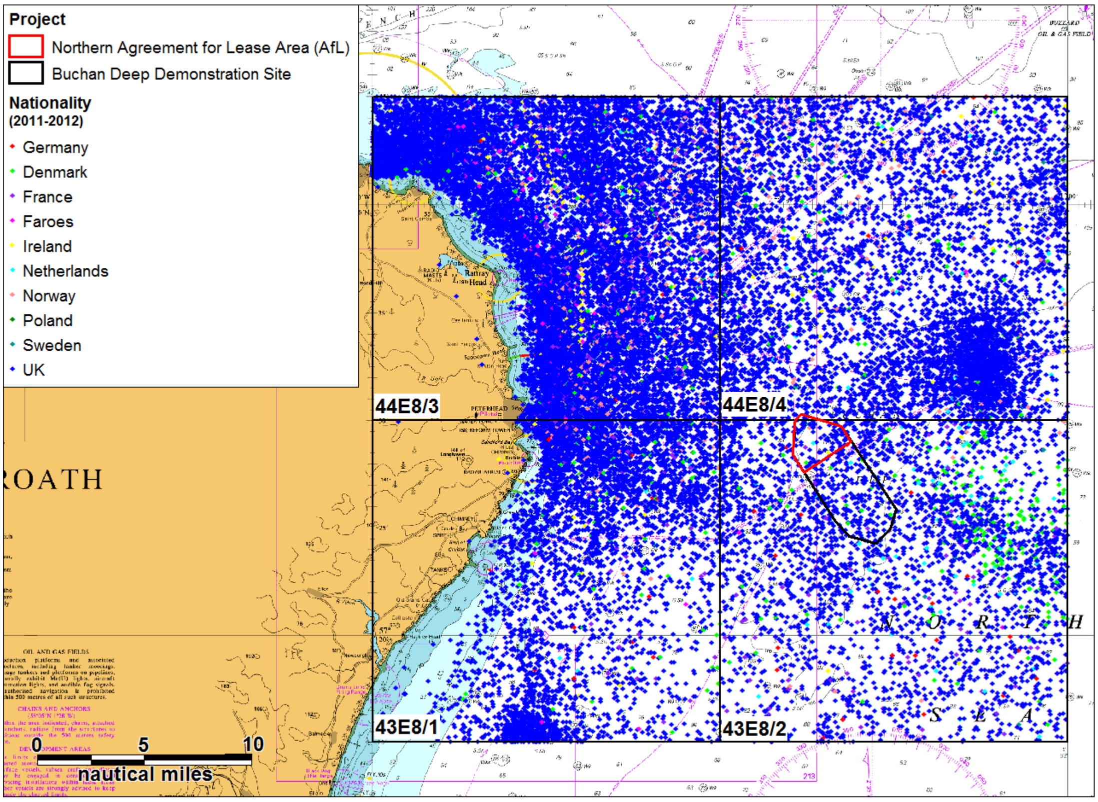


Figure 12.7 Fishing Vessel Satellite Positions by Nationality

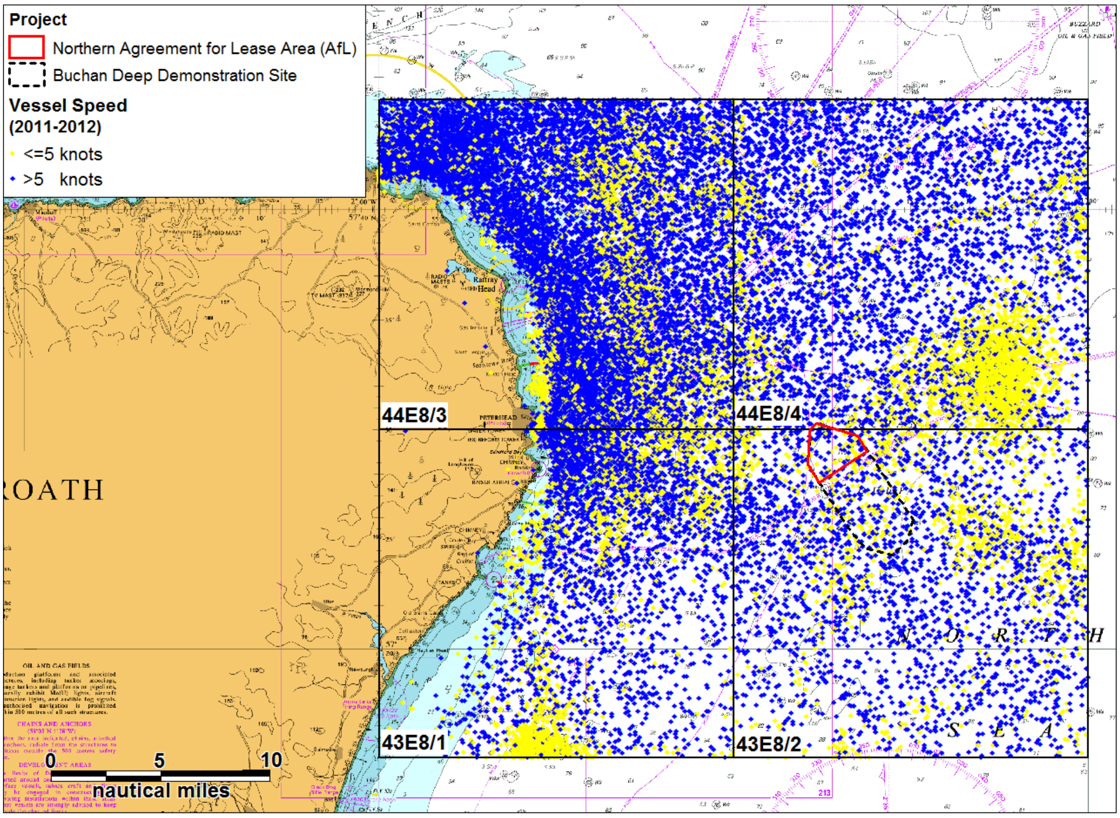


Figure 12.8 Fishing Vessel Satellite Positions by Speed

Overall, the majority of fishing vessels tracked by satellite in the ICES Subsquares (94%) and within the Northern AfL area (93%) were registered in the United Kingdom. Other countries present included Denmark, Norway, France, Ireland and The Netherlands.

In terms of speeds, approximately 60% of vessel positions within the Northern AfL area were at speeds above 5 knots and hence likely to be steaming on passage through the Northern AfL area. The remaining 40% were travelling at speeds below 5 knots and hence may have been engaged in fishing.

VMS data covering a different time period (2008-9 and 2011-12) were also analysed to review seasonal variations. This is presented in Figure 12.9 and displays the monthly distribution of vessels travelling at speeds of 5 knots or below (thus likely to be engaged in fishing) within 2nm (approx.) of the Buchan Deep Demonstration Site.

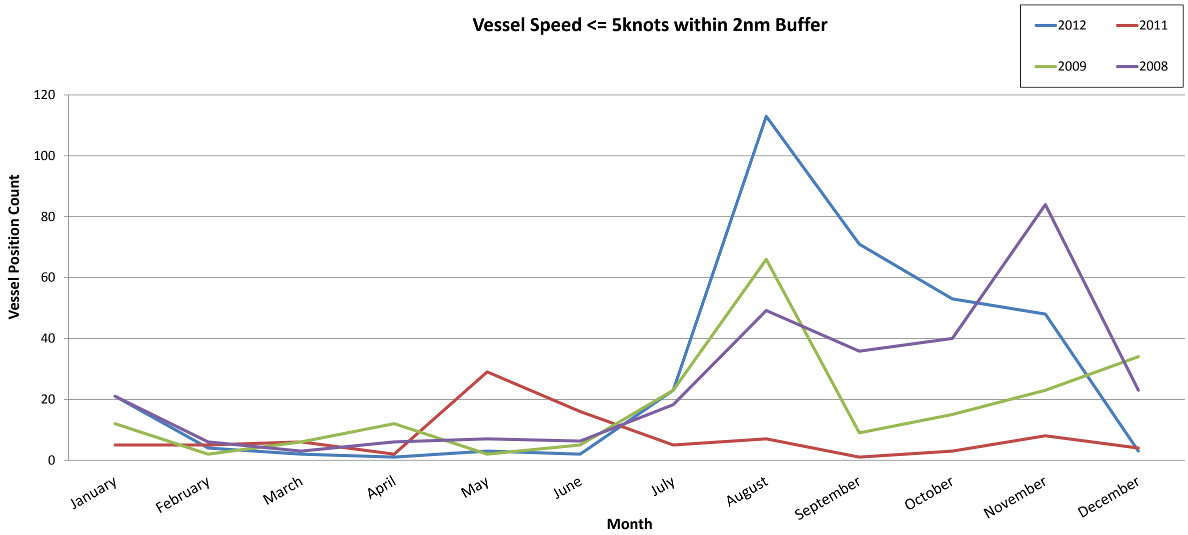


Figure 12.9 Fishing Vessels travelling at speeds of 5kn or below, recorded within 2nm by Month

The busiest month overall was August 2012, with over 100 fishing vessel positions recorded. August was also the busiest month in 2009, and the second busiest month in 2008. The busiest month in 2008 was November, whilst in 2011 it was May.

The busier months tended to be in the second half of the year, particularly August to November. The quietest months tended to be February to June, with the exception of 2011 when May, and to a lesser extent June, were relatively busy.

A combined graph of the total positions recorded at 5 knots or below in each month, combining all four years, is presented in Figure 12.10.

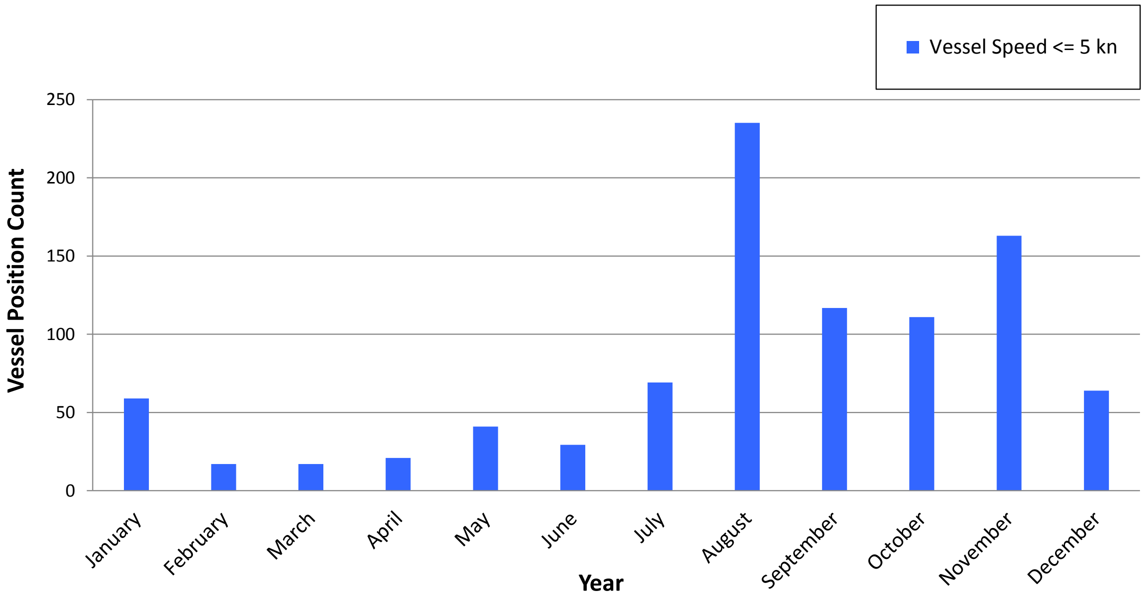


Figure 12.10 Fishing Vessels travelling at speeds of 5kn or below, recorded within 2nm by Month (2008-9, 2011-12)

12.6 Commercial Fisheries EIA

The Commercial Fisheries chapter of the Environmental Statement (Statoil, 2014b) describes fishing activity in the vicinity of the Hywind Scotland Pilot Park Project. The research used VMS data, Marine Scotland landings and effort data (all for a period of 2008-2012) as well as Marine Scotland ScotMap data (based on interviews with the inshore fleet, representing vessels under 15m in length, for 2013), to characterise fishing activity in the vicinity.

The report used a 12nm buffer of the Northern AfL area as a Study Area, with a local study area in the vicinity of the cable route.

Most vessels which actively fished within the Northern AfL area were registered within the UK. In terms of key commercial species, the only species which have been caught consistently over the period analysed are scallop, haddock, brown crab, mackerel and herring. This is a similar case for vessels under 15m length, with scallop and brown crab representing the highest value shellfish species for the inshore fleet.

The landings values within the Northern AfL area are relatively low when compared to the immediate vicinity of the Study Area and in ICES rectangles 43E8 and 44E8. Shellfish, demersal and pelagic fisheries work within both ICES rectangles 43E8 and 44E8. By volume (tonnes) the pelagic fishery is largest although the shellfish fishery lands a greater value of fish in 43E8. In 44E8 the shellfish fishery is largest in terms of both economic value (£) and live weight (tonnes).

The average landings value for larger vessels using mobile gear within the Study Area are high. Furthermore, lower landings values of inshore fisheries (west of the Northern AfL area) are not restricted to vessels less than 15m, but applies to vessels over 15m operating in these areas as well. However, the lower landings values of over 15m vessels in inshore areas combined with higher intensity of effort than offshore areas indicates that it is the demersal and pelagic fishery that are principal in the offshore area, i.e. where there is overlap with Buchan Deep; predominantly demersal trawling for whitefish such as haddock, and pelagic trawling for herring and mackerel, generating high landings values relative to effort. The principal fishing activities in the inshore areas are scallop, crab and lobster, and the line fisheries.

The majority of vessels operating in rectangle 43E8 and 44E8 are based at local ports. Peterhead is the principal landing port in the area, with an estimated 71% and 73% of active vessels landing catch from ICES rectangle 43E8 and 44E8, respectively. This is followed by Fraserburgh (20% and 74% of active vessels landing from ICES rectangle 43E8 and 44E8 respectively).

13. RECREATIONAL VESSEL ACTIVITY

13.1 Introduction

This section reviews recreational vessel activity in the vicinity of the Pilot Park Study Area based on the available desktop information and consultation with the RYA and CA.

13.2 RYA Data

The RYA, supported by the CA, has identified recreational cruising routes, general sailing and racing areas in the UK. 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 results of this work were published in Sharing the Wind (RYA, 2004) and updated GIS layers published in the Coastal Atlas (RYA, 2008).

An overview followed by a more detailed plot of the recreational sailing activity and facilities in the Northern North Sea Area is presented in Figure 13.1 and in Figure 13.2.

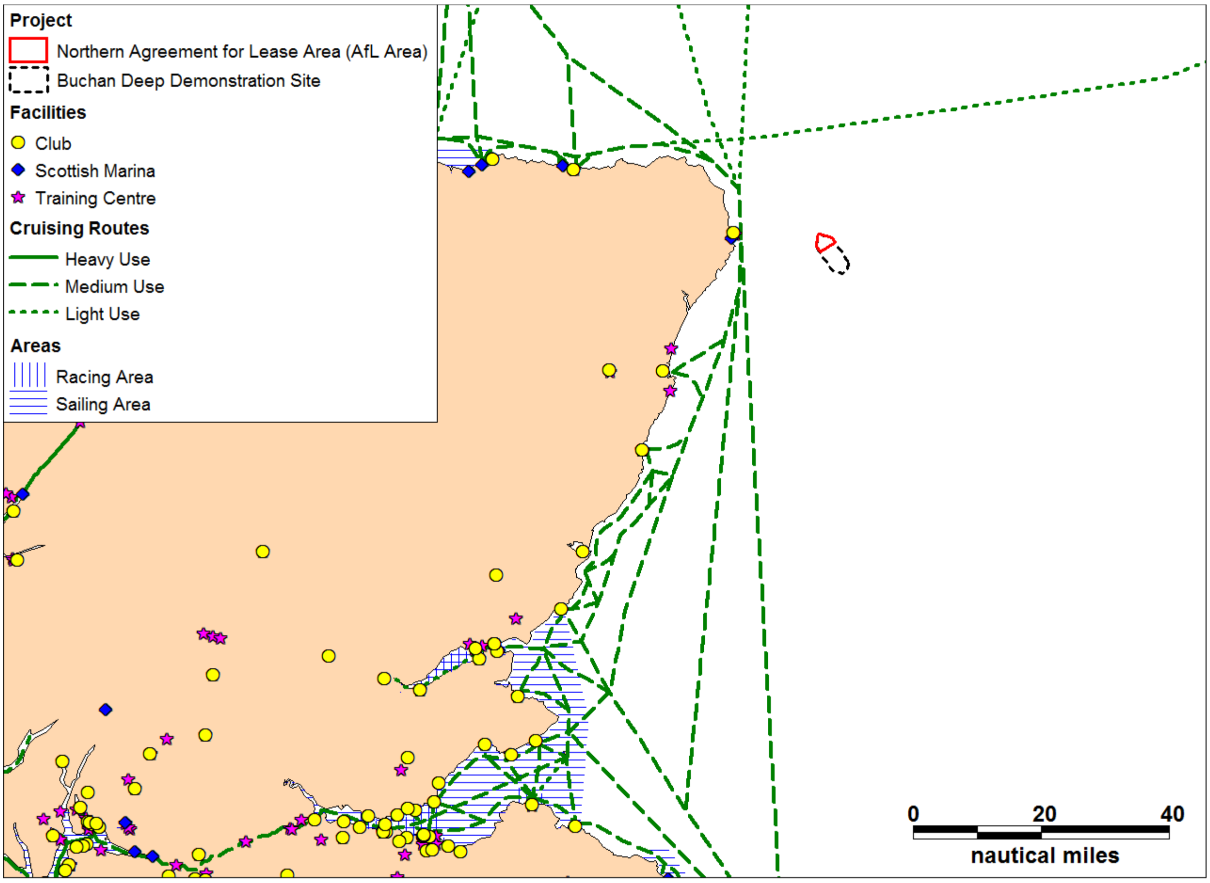


Figure 13.1 Recreational Information for Northern North Sea Area

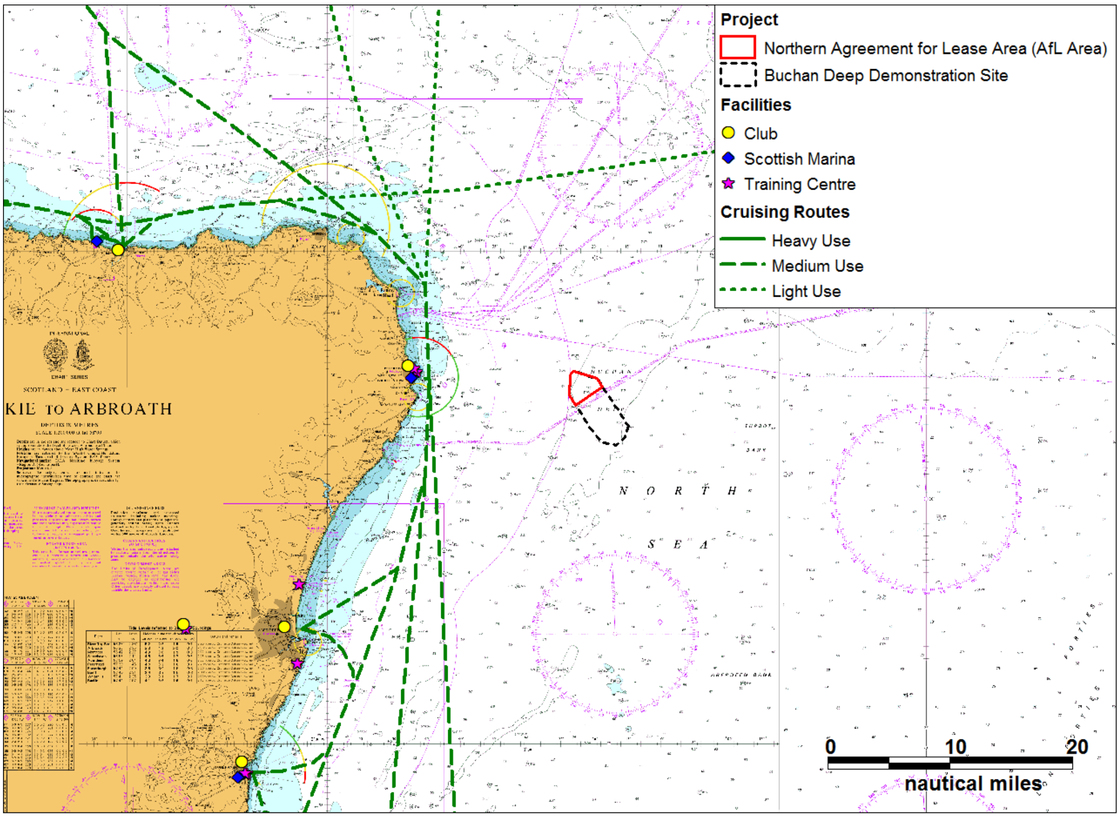


Figure 13.2 Recreational Data relative to Hywind Scotland Pilot Park Project

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.

Based on the RYA published data, the Northern AfL area is well outside the general racing and sailing areas. There are also no cruising routes crossing the Northern AfL area, as they all stay much closer to the shore. The nearest indicative route is 11nm to the west.

In terms of facilities, the nearest club is the Peterhead Sailing Club, 12nm west of the Northern AfL area, and the closest marina is Peterhead Bay Marina which consists of 150 berths. Vessels of up to 22m in length can be accommodated. The available depth of water at the entrance to the marina is 2.3m below Chart Datum although vessels up to 2.8m draught can lie afloat at the deepest berths.

13.3 Survey Data

A total of 12 recreational vessels were tracked on AIS during the summer 2013 and spring 2014 survey periods within the Pilot Park Study Area. No recreational vessels were recorded in the autumn 2013 or winter 2014 surveys.

Figure 13.3 presents the recreational vessel tracks identified from the surveys, within the Pilot Park Study Area.

It is noted again that AIS carriage is not mandatory for recreational vessels although some carry it voluntarily, especially larger vessels on longer routes. However, it is expected that AIS only represents a small minority of recreational traffic.

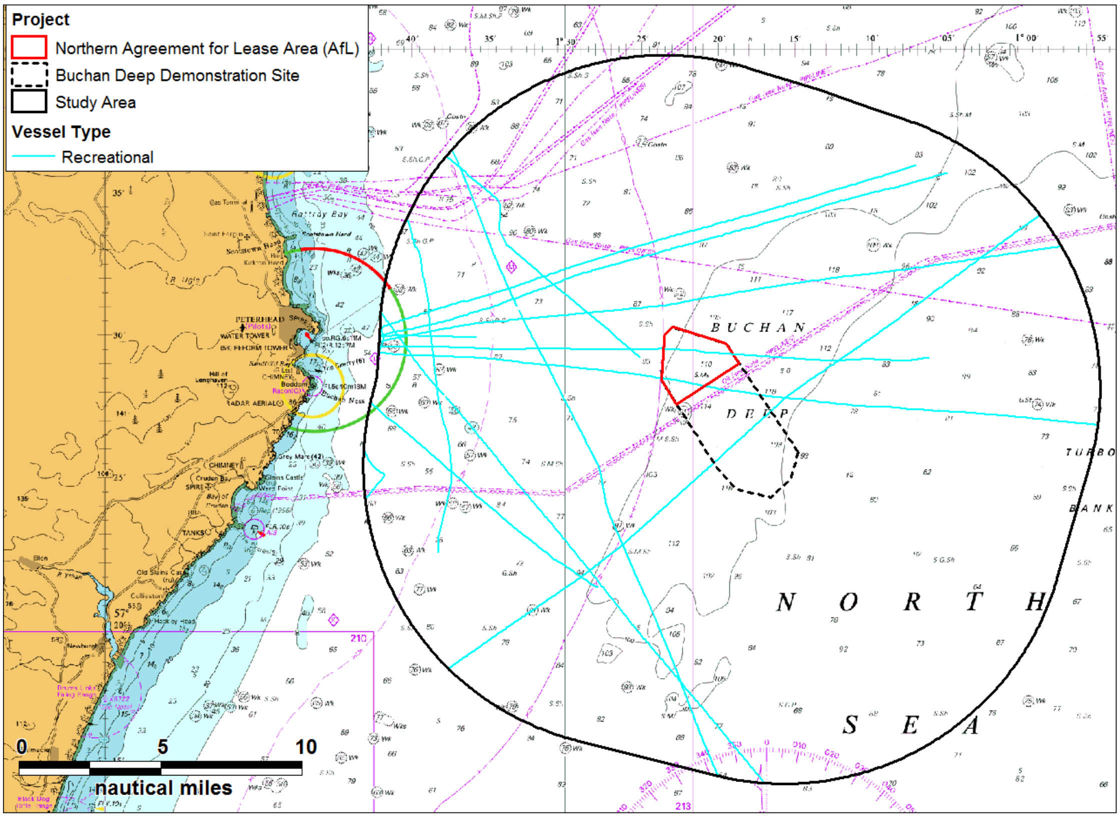


Figure 13.3 Recreational Vessel Survey Tracks within Pilot Park Study Area (16 Weeks AIS)

Two recreational vessels, both small sailing vessels, were tracked transiting through the Northern AfL area. *Noa Noa II* transited east on 7 August 2013, and *Altair Af Skaftoe* travelled east-southeast on 19 August 2013.

13.4 Clyde Cruising Club Sailing Directions

The Clyde Cruising Club produces Sailing Directions for various areas of Scotland. The publication covering the north east coast of Scotland (Clyde Cruising Club, 2010), which was compiled with local knowledge, includes information for recreational sailors in the vicinity of Peterhead.

13.4.1 Peterhead

For yachts this harbour with marina facilities offers excellent shelter in all weather. The extensive breakwaters make the harbour accessible in all but the most severe conditions. Due to the amount of commercial oil and fishing traffic, all vessels must contact Harbour Control on VHF channel 14 when entering or leaving. The old north entrance to the harbour is closed off.

On approach, the rocky headlands north and south of Peterhead Bay must be given a berth of at least four cables. Approach the entrance between the outer breakwaters on a westerly heading to pick up the leading line of 314°. In strong to gale northeast and southeast winds the backwash from the breakwaters causes much turbulence. Accordingly early acquisition of the leading line at a distance of not less than five cables off the entrance is advised. By day this is a transit of two orange masts each topped with a W triangle. When approaching the Marina the rocks and shoal water on the starboard hand marked by a G buoy should be noted.

Anchoring in Peterhead Bay is permitted only with the consent of Harbour Control. Sandford Bay 1nm south and subject to swell provides temporary anchorage in 4m in sand.

When berthing, the principal commercial harbour should be avoided, but if intending to enter that harbour, the Harbour Control should be contacted. There is a minimum depth of 2.3m at LWS in the entrance to the Marina. In the deepest berths there is 2.8m.

13.5 Peterhead Bay Marina

Peterhead Bay Marina is a purpose-built leisure facility for local and visiting recreational users. Due to its easterly position, Peterhead is well located to serve as a safe stopover point for vessels heading to and from Scandinavia. The marina is also used extensively by vessels heading along the east coast to the Caledonian Canal and sailing areas on the west coast of Scotland. Vessels of up to 22m in length can be accommodated at Peterhead Bay Marina.

Consultation with the Marina Manager confirmed that there are several visits per year from Scandinavia which could pass in the vicinity of Buchan Deep, but the vast majority of their visitors are coming from other directions, e.g., north or south.

Official records were not available but it is estimated that around 20-30 yachts per year are visiting Peterhead Marina to or from a direction that could take them passed Buchan Deep.

14. CABLE ROUTE REVIEW

14.1 Introduction

This section presents a more localised analysis of the maritime traffic data for a 2nm buffer surrounding the Hywind Scotland Pilot Park Project cable route (the Cable Route Study Area), using the most recent 28 days of AIS data from spring 2014. As before, vessels working on behalf of the Project have been excluded.

14.2 Vessel Analysis within Cable Route Study Area

A plot of the AIS tracks, thematically mapped by vessel type as broadcast on AIS, is presented in Figure 14.1.

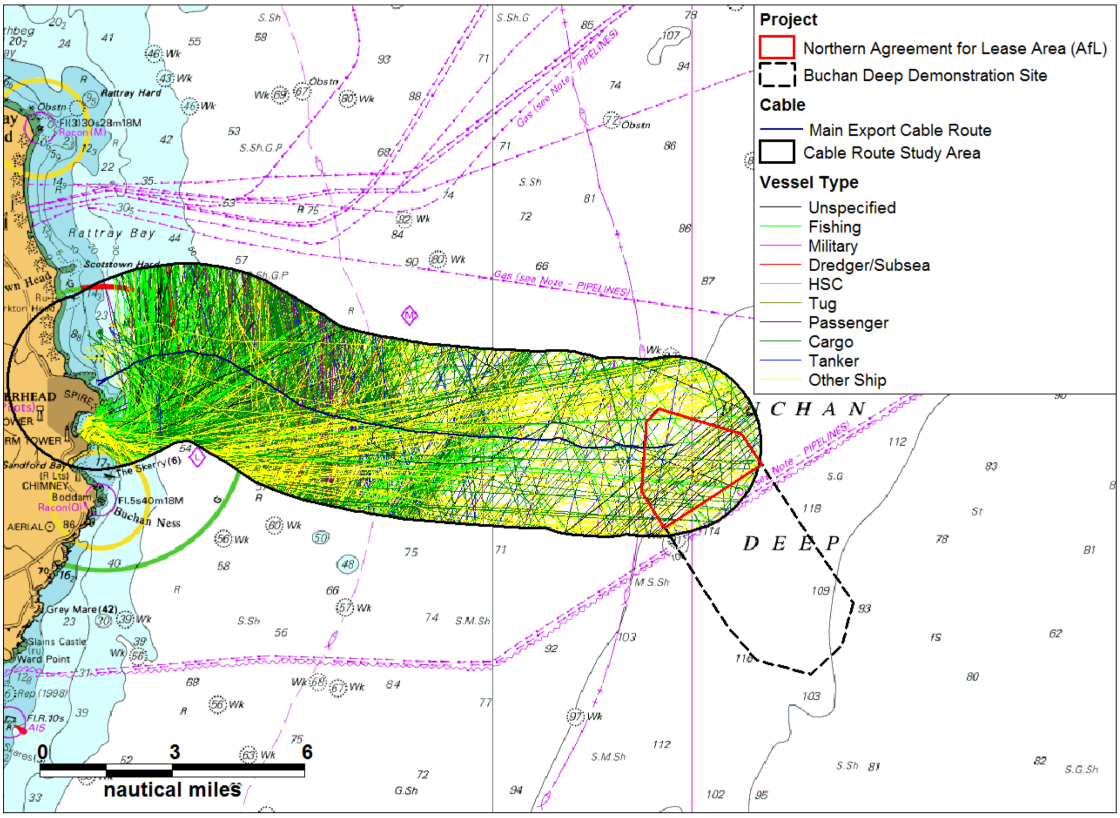


Figure 14.1 Spring 2014 AIS Data (28 Days) within Cable Route Study Area

An average of 64 unique vessels per day were recorded within the Cable Route Study Area, with the most common being identified as cargo (33%) and 'other' (28%) (mainly oil & gas), and fishing (27%).

14.3 Fishing Tracks

Figure 14.2 presents a plot of the fishing vessel AIS tracks from the 28 day spring 2014 period within the Cable Route Study Area.

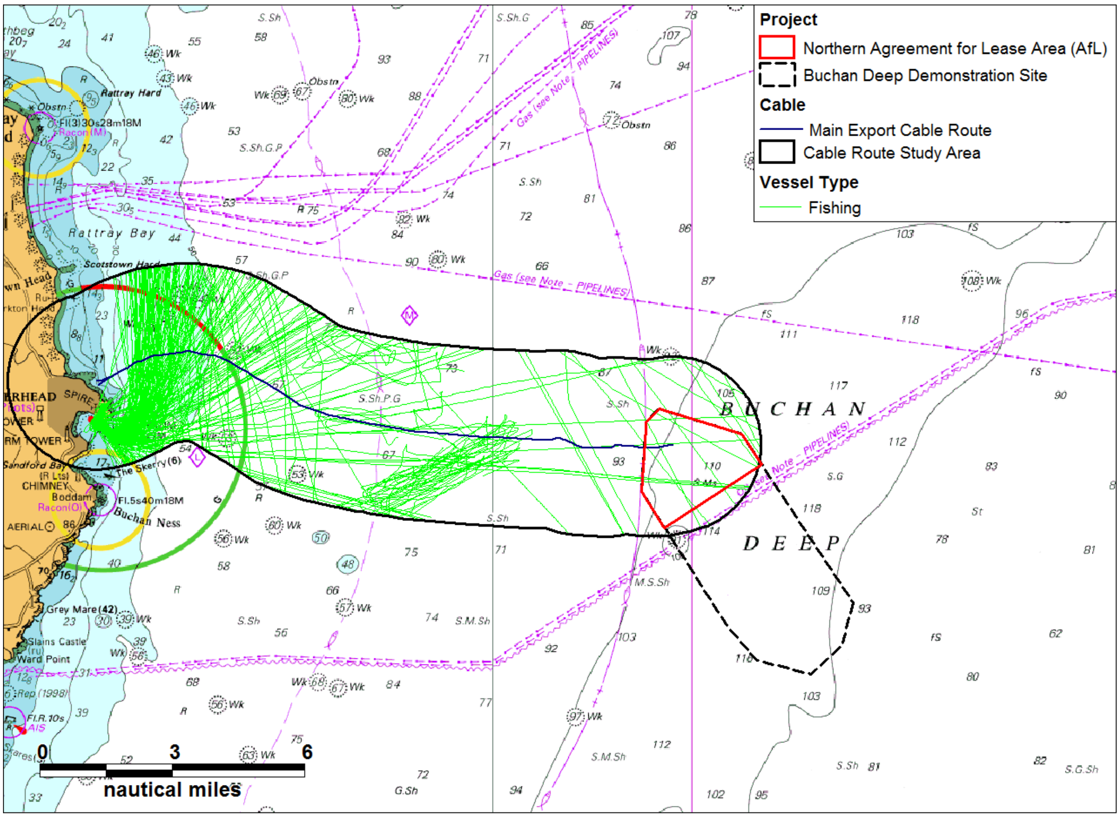


Figure 14.2 Fishing Vessel Survey Tracks (28 Days AIS) within Cable Route Study Area

An average of 16 unique fishing vessels per day were recorded within the Cable Route Study Area over the spring 2014 period. The majority of these appeared to be transiting vessels steaming on passage to or from Peterhead. However, it should be noted that AIS at the time was only mandatory for vessels 18m in length and above which will not fully represent fishing activity in inshore waters by smaller vessels. The AIS shows some evidence of fishing between the 6 and 12 mile fisheries limits.

The sightings data (all sizes) and satellite data (15m length and above) presented in Section 12 for ICES Rectangles 43E8 and 44E8 encompasses the export cable route. As with AIS, the satellite data does not represent smaller fishing vessels, covering only vessels over 15m in length, with the majority travelling at steaming speed. The sightings data includes all vessels and indicates a mixture of fishing and steaming activity but is based on a limited number of overflights.

The Commercial Fisheries chapter of the Environmental Statement (Statoil, 2014b) notes that ScotMap outputs indicate that the cable route will have the greatest impact on the under 15m fleet, mainly on fisheries targeting squid, mackerel and creel activity for crab and lobster. The value of scallops landed by under 15m vessels indicate that fishing effort in the area of the export cable is not as high as the over 15m vessels. A very low level of netting activity, i.e. for the salmon and sea trout fishery, was identified in the vicinity of the export cable corridor.

14.4 Anchored Vessels

Figure 14.3 presents the tracks of the vessels recorded anchoring within the Cable Route Study Area during the 28 day spring 2014 period.

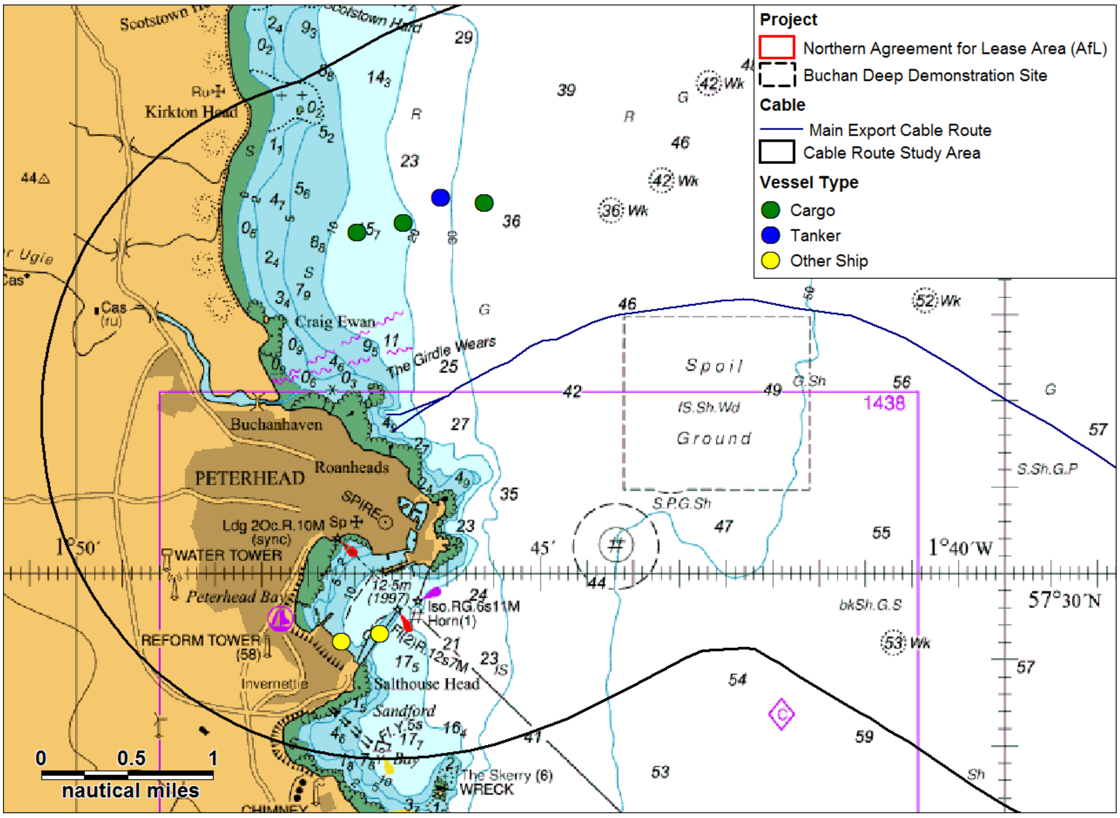


Figure 14.3 Anchored Vessel Survey Tracks (28 Days AIS) within Cable Route Study Area

Five vessels were recorded anchoring within the Cable Route Study Area over the 28 day spring 2014 period. *Blue Fighter*, an offshore supply vessel, was tracked within Peterhead Bay. Three cargo vessels and one tanker were recorded anchoring within the Cable Route Study Area, just north of Peterhead.

15. CONSULTATION

15.1 Stakeholder Meetings

In addition to the Hazard Review Workshop, which is summarised in Section 16 and fully reported in Appendix A, meetings with the following navigational stakeholders were held during the NRA:

- Peterhead Port Authority;
- Maritime and Coastguard Agency;
- Northern Lighthouse Board;
- Royal Yachting Association;
- Scottish Fishermen's Federation; and
- Department of Energy and Climate Change.

Summaries of these consultation meetings are presented below.

15.1.1 Peterhead Port Authority

A meeting was held at Peterhead Port Authority Office in Peterhead on 11 July 2013.

- Statoil explained although fabrication and assembly of the turbine units is expected to take place elsewhere (assembly on west coast), Statoil will most likely be looking to use Peterhead Port as main base for the storage and deployment of other components for the Project e.g. anchors, mooring chains and cables and would require access to berths of sufficient size and depth to accommodate anchor handling vessels. Would also require lay down area and areas for crew change etc.

- Statoil will be looking to use Peterhead Port as the operations and maintenance base for the Project long term, with berths or anchorage for supply and maintenance vessels etc.

- Statoil will most likely also be looking to charter boats from Peterhead region to take people out to see the Pilot Park once operations begin (as per current trips to the Hywind I demonstration turbine in Stavanger).

- Peterhead Port offers deepwater berthing facilities at depths of up to 14 metres and provides services to broad range of industries including oil and gas, renewables, fishing and leisure (at the marina). The port is the largest port in Europe for whitefish with £150m value of landings per year. Oil and gas also brings in £3m profit per year for the Port.

- ASCO located at South Base Quay is main supplier of supply chain solutions to oil and gas industry handling wide range of vessels involved in oil and gas operations including tankers, supply vessels, etc.

- The Port was extended in 2010 following construction of Smith Quay which has a deepwater facility which can accommodate vessels up to 180 metres in length. The

Port Authority is currently preparing a masterplan for the redevelopment of the north harbour area and dry docks. Also currently working towards establishing Peterhead as a green 'Eco-Port'.

- The Port operate a VTS (radar and AIS traffic monitoring) but mainly focused on access to the port. They can track vessels on radar out at Buchan Deep, but may not track all smaller vessels reliably at that range.

15.1.2 Maritime and Coastguard Agency

A meeting was held at the MCA's offices in Southampton on 23 July 2013. Key issues were as follows:

- MCA questioned lifespan of mooring lines and what replacement plans will be in place for moving parts. Statoil stated that the chains / lines will be inspected and maintained under an inspection regime. There will also be a full inspection of each turbine every year.

- MCA stated that Statoil should be aware of all the requirements of MGN 371 and noted that Statoil will require to make survey data available to the appropriate standard (Order 1A) for UKHO to update charting information.

- Consideration will require to be given to marking of the structures during towing operations. This would be considered as part of the risk assessment of the towing operations.

- SAR operations were not seen to be a big issue for such a small site, but would become an issue for any larger developments.

- The issue of fishing inside the area was discussed and the possibility of a trawl-free zone. The MCA questioned how enforceable this would be and the potential difficulties in establishing such a zone. Further discussion will be needed as the project progresses as this would require justification.

- MCA stated that Statoil would need to discuss markings of the structures with NLB and make sure issues are covered such as remote switching of fog signals as opposed to these just being automated.

- With respect to the survey requirements for the site, the MCA noted that it was a relatively small scale development. However, given that the fishing activity was a key issue, robust data and consultation with the industry would be needed.

15.1.3 Northern Lighthouse Board

On 6 August 2013 a meeting was held at Xodus' Edinburgh office to discuss the Hywind Scotland Pilot Park Project with the NLB.

- Due to the size and location of the Pilot Park, NLB confirmed it has no concerns about the Project in terms of risks to navigational safety.

- Markings and navigational aids such as buoys are likely to be required during installation. Buoys are unlikely to be required during operation.

- Standard lighting will be required on the WTG Units during operation. It was recommended that Statoil request a derogation from CAA to use flashing Morse W synchronised lighting for aviation rather than specified fixed red lighting as this can cause confusion to ships.

- Further discussion needed about towing operations once assembly location and tow route confirmed.

15.1.4 Royal Yachting Association

A meeting was also held with the RYA on 6 August 2013 at Xodus' Edinburgh office to discuss the RYA's interest in the Hywind Scotland Pilot Park Project.

- It was noted at the meeting that the RYA position statement recommends a minimum air gap of 22m above Mean High Water Springs (MHWS). In the case of floating turbines, the design air clearance would be constant in all tidal states.

- RYA noted that there are no local sailing clubs in the Peterhead area.

- The RYA Cruising Atlas is in the process of being updated, however current routes remain indicative of sailing routes in the area of Peterhead.

- The marina at Peterhead is currently used as a stop-off point for people heading to / from the Northern Isles via the east coast. Cruising vessels are very unlikely to be passing through the Buchan Deep. There are limited trips east / west between Peterhead and Stavanger, etc.

- RYA noted that the main risk is collision with turbines. Due to distance from the coast, any vessels navigating through the Buchan Deep would be competent saiilors who should be able to avoid turbines, therefore reducing the potential for collision.

- Main mitigation is to ensure that electronic navigation charts are fully up-to-date and all developments are clearly marked.

15.1.5 Maritime and Coastguard Agency and Northern Lighthouse Board

A further meeting was held at the MCA's offices in Southampton on 26 November 2013, with the MCA and NLB.

- A discussion was held with respect to Safety Zones around the individual turbines for normal operations. MCA stated that the risk assessment and case for such safety zones as well as all mitigation options be prepared as soon as possible.

- MCA respected that the floating turbines present a different case to conventional fixed offshore wind turbines. It was noted that it was unlikely that a safety zone of greater than 500m could be applied for. Notes on charts similar to other floating structures (e.g. chains and anchors) may be appropriate e.g. advisory areas beyond the 500m safety zone radius. It was also noted that safety zones could not just be for fishing vessels.

- With respect to construction operations, Safety Zone applications are accepted without question.

- With respect to towing the turbines to site, it was also noted that MCA would expect to see a risk assessment with appropriate consideration to mitigation for the towing of turbines to site from the deep-water port selected.

- It was agreed that, given the observations from the *Franklin* survey vessel where all fishing vessels in the area were already on AIS, an extended AIS survey could be used to develop the baseline for the Project as opposed to carrying out a dedicated vessel survey. It was noted that this should be supported by other, long-term, datasets such as VMS and sightings, as well as further consultation.

- The MCA raised the issue of mooring lines being in situ prior to the turbines being installed and how this would be charted and marked (possibly with buoys).

- MCA stated there had been issues with other wind farms using floodlights on the turbines and not being able to control such lights from shore.

- In terms of aviation lighting, a red synchronised flashing Morse W will be required. This will need to be agreed with CAA.

- With respect to chart markings, UKHO will not want to overload the charts and chart warnings could well be switched off on electronic charts.

- A discussion was held around the cable route and protection measures. Statoil is required to ensure that no significant reduction in navigable water depth takes place and that anchoring locations close to Peterhead have been considered.

15.1.6 Scottish Fishermen's Federation

Statoil and Xodus met with the SFF in Aberdeen on 5th July 2013 to discuss the Hywind Project:

- The site selection process was discussed and the potential for alternative sites.

- Statoil confirmed that the site would be operational for approximately 20 years, after which the turbines would be removed. There is no plan to extend the site beyond the five turbines. All large-scale developments will be located in deeper water further offshore.

- Arrangements for the geophysical survey were discussed to minimise the impact on fishing. SFF recommended having a Fisheries Liason Officer (FLO) onboard, which was agreed by Statoil.

- Statoil plan to bury the export cable and requested input from SFF on depth of burial. It was identified that there are sand waves on the way into Peterhead which will need to be taken into account. In terms of cable burial depth, a key consideration in area would be scallop dredgers.

- SFF confirmed the main species fished in inshore waters were velvet and brown crab and lobster. There is also a large amount of squid fished offshore.

Following the meeting, further discussions were held with SFF about the baseline data to be used to characterise fishing vessel activity. It was agreed that long-term VMS data, supported by seasonal AIS surveys, were appropriate for representing the fishing activity in Buchan Deep, as the majority of the vessels fishing in the area are 15m and above in length. The analysis indicated the fishing activity fluctuated widely during the year therefore the traditional winter and summer fortnights would not accurately capture all the monthly variations.

15.1.7 Department of Energy and Climate Change

A meeting was held at the DECC's offices in London on 11 June 2014 to discuss the possibilities with respect to the use of safety zones to exclude fishing activities from the Hywind Scotland Pilot Park Project to protect against risk to fishermen as well as damage to the project.

- The issue of fishing inside the area was discussed. It was explained that due to the anchor spread (approx. 750m), a 500m safety zone around the turbines would not be sufficient to protect fishermen from the hazard. It was also noted that anchoring would need to be prohibited in the area.

- DECC stated that the only option available through them were safety zones of up to 500m. It was not clear as to whether safety zones could be applied to for both turbines as well as subsea equipment. There would be no issue with having safety zones during construction operations.

- DECC stated that there was only one operational offshore wind farm in UK waters with operational safety zones of 50m (Greater Gabbard), and that in general these are objected to, particularly by the recreational community, such as RYA.

- For some other projects the MCA had suggested monitoring and review, once structures are installed, to assess whether there were vessels putting themselves and/or structures, equipment and personnel at risk (evidence-based approach). Statoil are to review this possibility.

- It was noted that there are fishing free zones within other wind farms in Europe (Denmark). Statoil / Anatec to review / consult to assess how these have been implemented.

- Further consultation on safety zones will take place as part of the Hazard Review Workshop.

- DECC stated that if an Area to Be Avoided (ATBA) was to be sought then this would need to be done through the MCA. There would need to be a clear understanding as to the legalities of the different options and what would be required with respect to monitoring and enforcement.

15.2 Consultation on the Preliminary Hazard Analysis

The following summarises the responses received to the Preliminary Hazard Analysis (PHA) submitted to Marine Scotland as part of the Scoping Report in October 2013.

15.2.1 Royal Yachting Association

RYA noted that the area proposed is one of the few places around the Scottish coast that is hardly frequented by recreational vessels. Although AIS signals are transmitted by only a minority of recreational vessels, RYA noted that the area will be crossed occasionally by some vessels on passage between Scotland and Norway and others crossing the North Sea forced to alter course due to adverse weather.

The RYA has recently published a revised edition of its Position Paper on Wind Offshore Renewable Energy Installations to which reference should be made, e.g. in relation to marking and lighting and air clearance.

15.2.2 Northern Lighthouse Board

NLB acknowledged receipt of the Scoping Opinion and PHA, and advised that until they are in receipt of the NRA they would be unable to give a specific marking proposal for the Project.

NLB noted the turbines will be towed out and connected to the pre-installed moorings and cables. It may be necessary to mark and light the site, moorings and chains or any riser or pickup lines and cable connectors deployed prior to the turbines arriving on site.

Marking and lighting will be required for each of the phases of the Project; construction, operation and decommissioning, to give the best possible indication to the mariner of the nature of the works being carried out. NLB also require that Notice(s) to Mariners, radio navigation warnings and publications in appropriate bulletins be issued stating the nature and timescale of and works carried out.

NLB has no significant concerns regarding the proposed Project.

15.2.3 Aberdeen Harbour Trust

Aberdeen Harbour acknowledged receipt of the Scoping Opinion and PHA. Subsequent contact during the project confirmed they had no concerns.

15.2.4 Maritime and Coastguard Agency

MCA noted that the provision of mooring cables, and floating and unburied inter-array cables will require to be managed within the array. It a 'zone of exclusivity' was created to manage vessel activity, this would require discussion.

MCA also stated that the towing of WTG Units to Buchan Deep will need to be addressed. (Note: this is not covered by the NRA; a separate towage operation risk review is planned.).

The mooring systems are required to be subject of a third party verification.

16. FORMAL SAFETY ASSESSMENT

16.1 Introduction

The impact assessment is based on the IMO Formal Safety Assessment process (IMO, 2002) approved by the IMO in 2002 under SC/ Circ.1023/MEPC/Circ392, and referred to in Section 2.4.

As indicated within the IMO FSA guidelines and the DECC guidance on risk assessment methodology (DECC, 2005) for offshore renewable projects, 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 Project is a medium-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 Navigational Risk Assessment for selected hazards
- Preliminary search and rescue overview
- Preliminary emergency response overview
- Comprehensive risk control/mitigation measures log

16.2 Hazard Identification

A Hazard Review Workshop was held in Peterhead on 25 June 2014, with attendees listed in Table 16.1

Table 16.1 Hazard Review Workshop Attendees

Organisation	Name
HSL	Sigmund Lunde
HSL	Jostein Bolstad-Lind
HSL	Amir Mohd Ghazali
Peterhead Port Authority	John Forman
Peterhead Port Authority	Sandy Watt
MRCC Aberdeen	Fiona Hastie
ASCO Marine and Marine Safety Forum (MSF)	Euan Simpson
NLB	Archie Johnstone
Peterhead Marina	James Clubb
RNLI	Alistair Wilson
Scottish Fishermen's Federation (SFF) Services	Andrew Buchan
SFF Services	Peter Duncan
Fishing Vessel Skipper	James Buchan
Fishing Vessel Skipper	Philip Buchan

Organisation	Name
Anatec	John Beattie
Anatec	Judith Murray

Representatives from the following organisations were invited but unable to attend:

- Chamber of Shipping
- RYA & RYA Scotland
- Cruising Association
- Bibby
- Craig Group
- GulfMark
- Vroon

(The last four companies are oil & gas industry support vessel operators. However, their interests were represented by Marine Safety Forum, of which they are members.)

The key maritime hazards associated with the Hywind Scotland Pilot Park Project were identified. The following hazards were discussed:

1. Powered vessel collision with WTG Unit;
   a. *Merchant ship (e.g., oil & gas);*
   b. *Fishing vessel; and*
   c. *Recreational vessel.*
2. Drifting vessel collision with WTG Unit;
3. Vessel-to-vessel collision due to avoidance of site and/or work vessels;
4. Fishing interaction with midwater mooring lines and power cables and anchors;
5. Fishing interaction with export cable;
6. Vessel anchor interaction with subsea equipment;
7. WTG Unit total loss of station; and
8. Work vessel collision with other vessel (during Installation / Maintenance)

The discussion was recorded at the meeting using Anatec's Hazard Log Software. A summary of key points made about each hazard is presented below. The full discussion is presented in Appendix A.

Hazard 1: Powered Vessel Collision with WTG Unit

- It was noted that the cause of a powered collision could be inadequate passage planning, such as using the site as a waypoint and failing to alter course.

- NLB suggested a phased and synchronised approach to marking and lighting, with this in place prior to the fully operational phase.

- Discussions have been held with the MCA and DECC regarding the potential for safety zones around turbines (up to 500m) although this is more aimed at protecting against fishing interaction with subsea equipment rather than surface navigation. It is expected that steaming vessels would seek to maintain an adequate clearance during passage, whether there are safety zones in place or not. MSF noted that the concept of safety zones is not new and that vessels operating off the east coast of the UK, especially oil & gas industry vessels (about two-thirds of the traffic in the area of the Hywind Scotland Pilot Park Project) are used to these zones being in place around fixed and mobile oil installations, including many subsea installations.

- It was suggested the frequency of the hazard of a powered collision would be low. A vessel would not intentionally want to collide with a WTG Unit, and would collide only if unaware of the presence of the Pilot Park Project. It was felt this would be the case with or without a safety zone.

- Overall, it was agreed there is always potential for a collision but the frequency is expected to be quite rare for the Hywind site. In terms of consequences, MSF suggested this would be less than for an oil & gas installation as the WTG does not have risers. Statoil commented that as it is a floating unit it will move away from a collision so a ship us unlikely to stem the turbine, a glancing impact is more likely.

- A guard vessel was identified as a key mitigation during initial activities, when awareness of the Pilot Park Project will be low. PPA suggested the vessel issue regular SECURITE messages to increase awareness. Information should also be included in Maritime Safety Information (MSI) broadcasts routinely made by the MCA for the area.

- How the site and associated cables, mooring lines and anchors are depicted on charts will need to be discussed with the UKHO.

- Peterhead Marina commented that charts on recreational vessels can be outdated, with the majority using Imray charts. There is a need to find out how these are updated, and make sure they are informed of the Project. Similarly for updating the relevant Sailing Directions and Almanacs. Local marinas and harbours can publicise the development on Notice Boards as electronic methods are not always effective. Consultation with equivalent bodies to the RYA in Norway and targeting foreign recreational users would also help promulgate information regarding the Pilot Park Project to leisure users.

<u>Hazard 2: Drifting Vessel Collision with WTG Unit</u>

- A vessel which loses power in the vicinity could drift towards the site under the influence of the prevailing conditions (wind and wave) and collide with a WTG Unit.

- There is good holding ground for anchoring in the vicinity.

- There is a good prospect of a suitable vessel oil & gas vessel being available to aid a drifting vessel. Although not guaranteed, this makes the Project safer than elsewhere in the UK for this scenario.

<u>Hazard 3: Vessel-to-Vessel Collision due to avoidance of Site or Work Vessels</u>

- Vessels will have to re-route around the five WTG Units which will alter the rate of encounters and therefore potential vessel-to-vessel collisions.

- NLB highlighted the problem with new navigation technology, such as GPS, which can result in all vessels altering course at the same waypoint which leads to convergence, e.g., vessels may insert a new waypoint in their passage plan 0.5 miles west or north of the Project.

- Radar effects caused by the structures will be low due to there being only five structures present.

- Overall, the reduction in sea room and re-routeing is likely to result in an increase in the risk of collisions. However, as the turbine locations occupy a relatively small footprint area of approximately 5km^2, the increase is likely to be marginal.

- It was also noted the presence of the Project will add an additional hazard for mariners to be aware of, which will potentially make them more vigilant when navigating through the area.

Hazard 4: Fishing Interaction with Midwater Mooring Lines and Power Cables and Anchors

- Fishing vessel gear will have the potential to interact with midwater mooring lines and power cables and anchors at the Hywind Scotland Pilot Park Project.

- SFF highlighted the necessity to make fishermen aware of the exact position of mooring lines and anchors via awareness charts (paper and electronic) issued by Kingfisher / FishSafe, as well as more generally via UKHO chart updates.

- Statoil would prefer to exclude fishing from the area, including the midwater mooring lines and power cables and anchors, for safety reasons (to protect mariners). Discussions have been held with the MCA and DECC regarding the potential for safety zones or an Area to be Avoided (ATBA) to achieve this. There is a mechanism to apply to DECC for up to 500m safety zones. The midwater power cables will have seabed touch down at a radius of approximately 250-300m. The anchors would extend a further 200-300m (approximately) beyond the safety zones if these were centred on the turbines. A risk-based case would need to be made to DECC / MCA therefore the question was asked whether stakeholders felt exclusion was necessary on safety grounds.

- NLB pointed out that anchor lines from drilling rigs and floating installations (e.g., FPSOs) in the North Sea extend outside safety zones. However, Statoil noted that these tend to be embedded anchors under the seabed whereas the suction anchors planned at Hywind will protrude above the seabed and pose an increased risk of interaction with trawled gear. Anchors are 6m in diameter, 18m long and will protrude approximately 2m. Statoil indicated that over-trawl protection is not a practical option.

- The fishermen accepted the need for safety zones around the turbines but felt they could "protect themselves" and manage the risks associated with fishing in proximity to lines and anchors. They would fish close to the 500m zone then pull off, avoiding crossing the lines and anchors.

- Other stakeholders present felt that an exclusion zone would help protect fishermen against unsafe practices, but the skippers felt that it was highly unlikely that a local vessel would take a risk, both on safety and economic grounds (potential damage to gear), and that raising awareness was the most effective safety measure.

- Mooring lines and anchors will be in place one year prior to the installation of WTG Units, thus there will be 15 mooring lines laid on the seabed for approximately one year before any surface structures are visible. SFF noted that these would pose a hazard to trawling but not to surface navigation. SFF suggested that guard vessel(s) would be required during and following installation of the mooring lines and anchors, until there is any surface structure present. The period of raising awareness should begin prior to installation of the mooring lines and anchors. NLB suggested that cardinal buoys could be used to physically mark the presence of a hazard on the seabed, with Admiralty Charts noting the position of the buoys.

<u>Hazard 5: Fishing Interaction with Export Cable</u>

- Fishing vessel gear will have the potential to interact with the export cable running from the Park to the landfall point along the coast at Peterhead (to be finalised). The export cable will be installed prior to the WTG Units.

- Once established, appropriate mitigation is needed to ensure the cable is suitably protected against the type of fishing (i.e., scallop and clam dredging) and anchoring in the area. This may include trenching, burial and the use of rock dumping, depending on the nature of the seabed.

- SFF considered it essential to have a guard vessel on site following installation of the export cable until it has been buried / trenched or otherwise protected. This is usually only a short time.

- Skippers confirmed they would fishing over and across the cable, on the assumption it is protected.

- It was noted a Burial Protection Index (BPI) study is usually carried out as a condition of the consent and submitted to the MCA prior to installation, as full details of the cable route and protection measures are not normally finalised at the time of the NRA.

<u>Hazard 6: Vessel Anchor Interaction with Subsea Equipment</u>

- Vessel anchors have the potential to interact with midwater mooring lines and power cables connected to the WTG Unit and anchors at the Statoil Hywind Pilot Park Project and with the export cable running from the Pilot Park Project to the landfall point along the coast at Peterhead.

- Anchoring is very unlikely in the deeper water of Buchan Deep, although it could take place by a transiting vessel in an emergency.

- It was noted by PPA that vessels do not routinely anchor east of Peterhead, but there is occasional anchoring off the coast to the north and south. There have been no recent reports of dragged anchor incidents in the area so this is an uncommon event.

Hazard 7: WTG Unit Total Loss of Station

- This hazard is that the mooring system fails, causing the WTG Unit to completely lose station and drift, causing a navigational hazard beyond the Park.

- The mooring system is being designed to DNV codes. The system is designed to be stable in the event of single line failure leaving two of the three lines in place (in fact there will be less tension as load will be shared by two anchors). This would lead to only a minor amount of additional excursion of the WTG unit from its central location (approx. 100m-200m). If this were to happen, an automatic alarm would sound and an emergency response would be initiated, e.g., vessel sent from Peterhead to investigate. Cables would not be affected as they will be designed with a Lazy 'S' configuration.

- Regular checks of the mooring system will be carried out by ROV.

- Statoil has 18 anchored oil & gas platforms in the North Sea which equates to over 4,000 anchor-line years with not a single line failure.

- It was noted that a WTG Unit which has lost station totally, i.e. all three mooring lines broken, may represent a threat to damage the BP's Forties Pipeline System in the vicinity of the park. The mooring system is, however, intact with two mooring lines working. DNV is currently undertaking a Risk Analysis of this threat.

- Worst case, if a turbine were to drift it would be likely to be stranded quickly if moving towards shore, given its deep draft. An emergency response plan will be developed for recovery, for example, using a towing vessel.

Hazard 8: Work Vessel Collides with Other Vessel

- Working vessels for the Project will have the potential to collide with other transiting vessels whilst operating in the site or en route to / from the site during construction, maintenance and decommissioning of the Project.

- Statoil highlighted that, once installed, the only routine vessel operations at the site will be a personnel craft for maintenance and an ROV support vessel for under water inspections.

- Guard vessel(s) may also be used temporarily to mitigate risks and increase awareness during the early stages.

- Rolling safety zones of 500m radii during construction are industry-standard to protect installation vessels and their personnel.

16.3 Hazard Ranking Methodology

The ranking of the risks associated with the various hazards was subsequently carried out based on the discussion at the Workshop and review of the baseline data and other consultation. This was circulated to attendees after the meeting for feedback. A risk matrix was used based on the frequency and consequence categories shown below.

Table 16.2 Frequency Bands

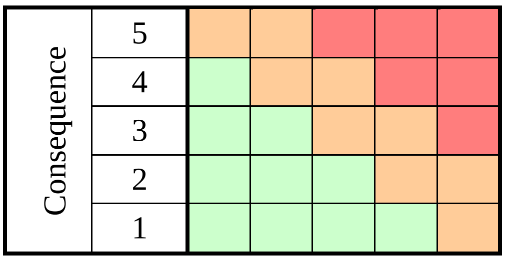
Rank	Description	Definition
1	Negligible	< 1 occurrence per 10,000 years
2	Extremely Unlikely	1 per 100 to 10,000 years
3	Remote	1 per 10 to 100 years
4	Reasonably Probable	1 per 1 to 10 years
5	Frequent	Yearly

Table 16.3 Consequence Bands

Rank	Description	Definition			
		People	Environment	Property	Business
1	Negligible	No injury	<£10k	<£10k	<10k
2	Minor	Slight injury(s)	Tier 1: Local assistance required	£10k-£100k	£10k-£100k
3	Moderate	Multiple moderate or single serious injury	Tier 2: Limited external assistance required	£100k-£1M	£100k-£1M Local publicity
4	Serious	serious injury or single fatality	Tier 2: Regional assistance required	£1M-£10M	£1M-£10M National publicity
5	Major	More than 1 fatality	Tier 3: National assistance required	>£10M	>£10M International publicity

The four consequence scores were 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.

Table 16.4 Risk Matrix



1	2	3	4	5
Frequency				

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.

The hazard was ranked by expected risk (based on the estimated frequency versus consequence) with no (or basic) mitigation measures applied, and residual risk following application of industry standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop. An example of the methodology and the full set of results are presented in Appendix A.

16.4 Risk Rankings

The final hazard log contained a total of 10 navigational hazards (due to Hazard 1 being considered under three different vessel types) with the following overall breakdown by tolerability region presented in Figure 16.1.

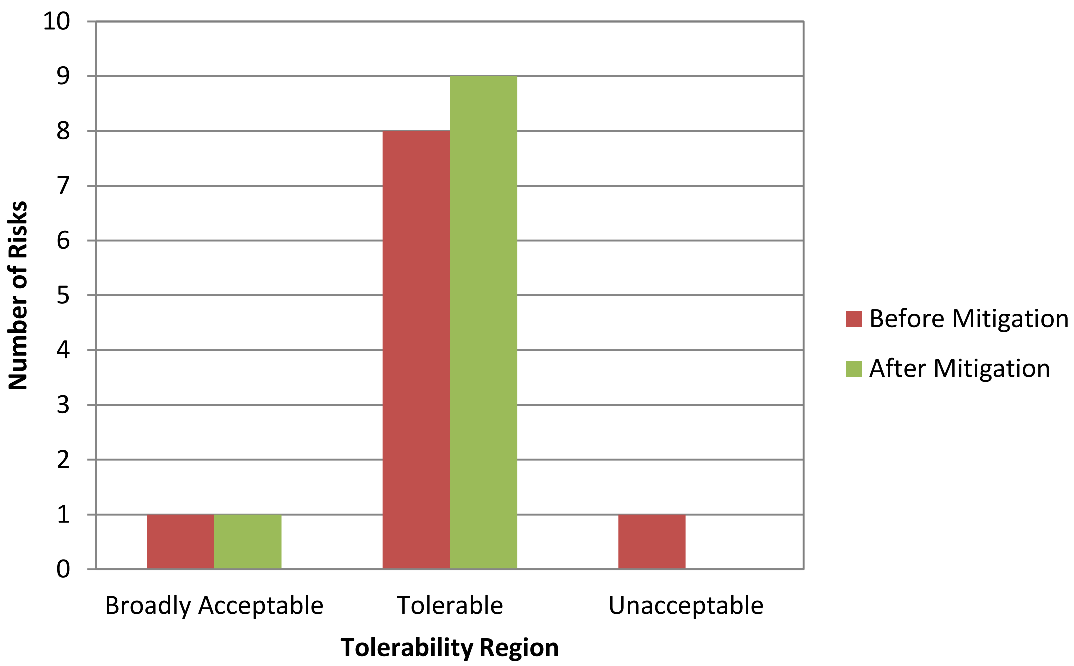


Figure 16.1 Hywind Scotland Pilot Park Project Risk Ranking Results

One hazard, fishing interaction with the midwater mooring lines and power cables and anchors, was assessed as being Unacceptable pre-mitigation. Potential mitigation measures identified at the workshop for this hazard are listed below:

- Abandon gear in event of snag;
- Marking and Lighting;
- Raising awareness of the Pilot Park project;
- Maritime Safety Information broadcasts;
- Notices to Fishermen;
- Fisheries Liaison;
- FishSAFE;
- Sharing of information within industry;
- Up-to-date charts;
- Kingfisher publications;
- Issue Notices to Mariners;
- Emergency contact available 24hrs per day;
- Emergency Response Cooperation Plan;
- AIS Monitoring;
- Guard vessel in period between mooring and turbine installation;
- Temporary buoyage in the period between mooring and turbine installation; and
- Exclusion of fishing in area of mooring lines and anchors.

By applying the appropriate mitigation, the risk was assessed to reduce to a Tolerable (ALARP) level.

Eight other hazards were identified as being Tolerable before mitigation. However, there is still a requirement that such risks are properly assessed and appropriate control measures are put in place to ensure the residual risks are ALARP. The potential mitigation measures identified for each hazard are listed in Appendix A.

One hazard, WTG unit loses station, was ranked as Broadly Acceptable based on the significant redundancy in the mooring system already built-in to the design.

Further details on all hazards identified (including causes, frequency and consequence rankings and potential risk control/mitigation measures) are recorded in the Hazard Log (see Appendix A).

16.5 Risk Assessment

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 level of risk
2. Base case with wind farm level of risk

3. Future case without wind farm level of risk
4. Future case with wind farm level of risk

(Base case uses current traffic levels and future case uses future traffic levels based on predicted change over the life of the Hywind Scotland Pilot Park Project.)

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)
- 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 (DECC, 2005). 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
- Comparison with the real world

The results of the detailed risk analyses are presented in Section 17. Where considered appropriate in high risk scenarios, the change in individual and societal risk (based on Potential Loss of Life (PLL)), as well as the risk of pollution, were calculated and compared to background risk levels in the UK.

16.6 Risk Control Options

The different risk control measures/options were identified within the hazard ranking process. Full details of the measures are presented within the Hazard Log (Appendix A). A summary of measures adopted by the project is presented in Section 23.

17. RISK MODELLING AND ASSESSMENT

17.1 Introduction

This section assesses the risks identified from the hazard review to require 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 levels identified from the maritime traffic survey, consultation and other data sources.

The future case assessment considers potential changes in shipping traffic over the estimated 25 year operational life of the Hywind Scotland Pilot Park Project.

17.2 Base Case Without Project Risk

17.2.1 Base Case Vessel to Vessel Encounters

An assessment of current ship-to-ship encounters within 5nm of the Northern AFL area has been carried out by replaying at high-speed seven days of spring 2014 AIS survey data. Figure 17.1 presents the number of encounters per day, where an encounter has been defined as vessels passing within 1nm of each other.

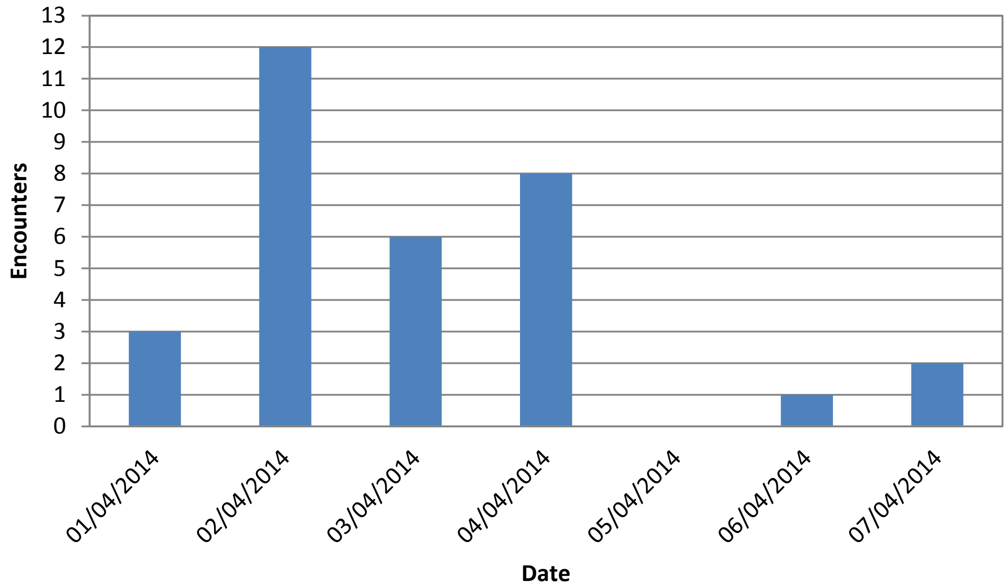


Figure 17.1 Number of Encounters per Day

The average number of encounters was four to five per day, with the highest number (12 encounters) observed on 2 April 2014.

Figure 17.2 presents the distribution of vessel types involved in encounters.

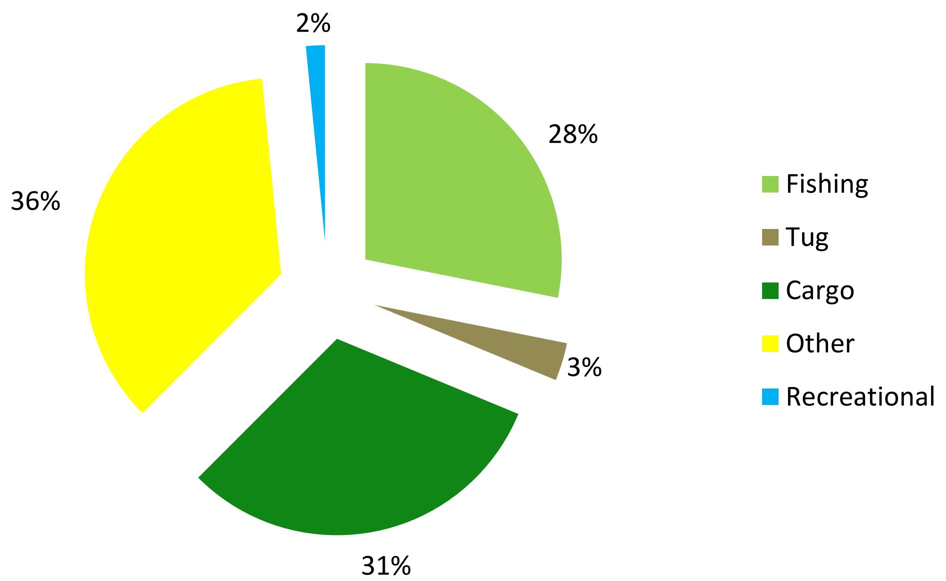


Figure 17.2 Vessel Types Involved in Encounters

It can be seen that the highest number of encounters involved 'other' vessels (36%), followed by cargo vessels (31%) and fishing vessels (28%). When further classifying all of these vessels, it was noted that 66% of vessels involved in encounters were offshore industry vessels, which is in-line with the overall traffic levels in the area.

The locations of encounters, showing the tracks of vessels when passing within 1nm of each other, during the seven day period are presented in Figure 17.3.

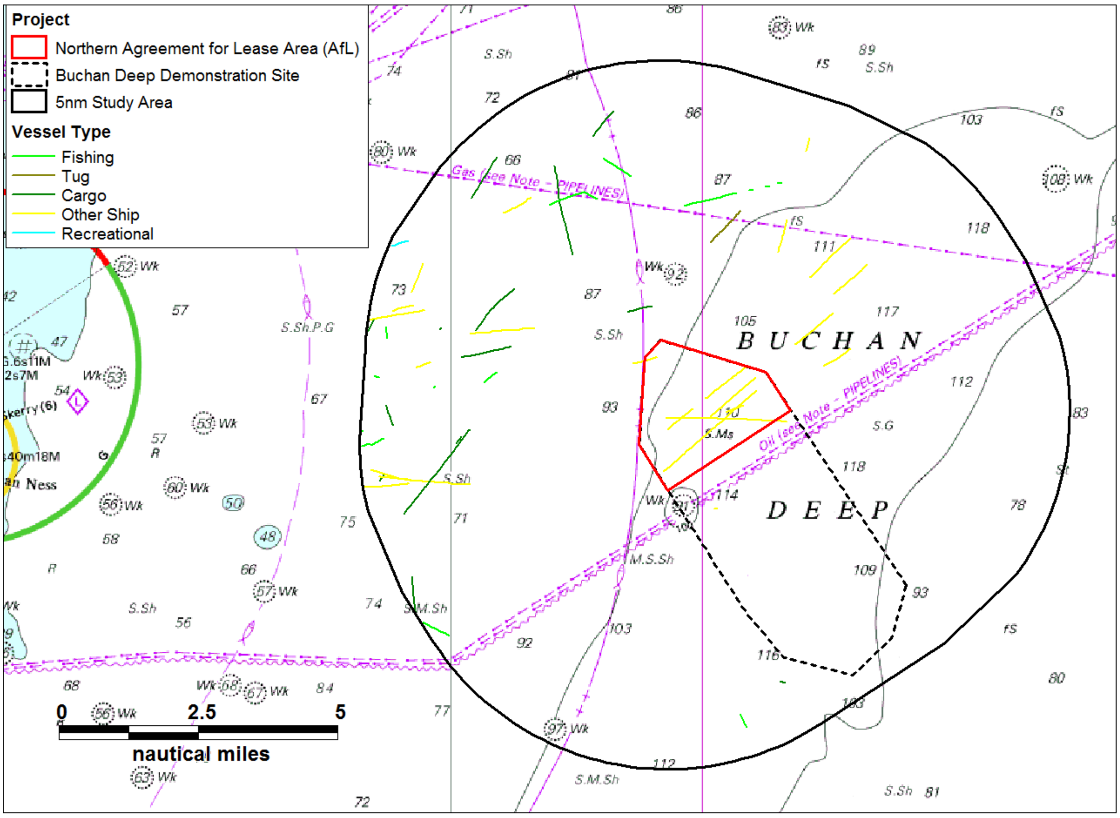


Figure 17.3 Overview of Encounters (vessels within 1nm of each other) during Seven Days in Spring 2014 (AIS)

It can be seen that vessels encountered each other at various points within the area considered, including encounters by 'other' ships (which were offshore industry vessels) within the Northern AfL area. However, none of these are considered hazardous events as there is ample sea room in the area.

17.2.2 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 vicinity of the Northern AfL area. The route positions, widths and traffic levels are based on the survey analysis, which take into account seasonal variations.

Based on the model run for the area, the baseline vessel-to-vessel collision risk level is in the order of 1 major collision in 51.2 years[4].

It is emphasised the model is calibrated based on major incident data at sea which allows for benchmarking but does not cover all incidents, such as minor impacts, or incidents occurring

[4] Note that the models have been calibrated against 'serious' casualty data at sea. This excludes incidents in port, e.g., minor bumps during berthing, requires the incident to be of a defined degree of seriousness in terms of loss of life, environmental damage and/or financial impact. Non-serious casualties are estimated to be in the order of 4 times more frequent than serious casualties. Anatec's models are calibrated against serious casualties as this minimises the probability of under-reporting and provides a benchmark level when comparing the frequency of accidents in different parts of the World.

within port. Other incident data from RNLI and MAIB is presented in Section 10. This includes incidents where there was negligible or minor damage including low-speed collisions in port.

17.3 Base Case with Project Risk

This section presents the base case results, i.e., based on current traffic levels identified from the survey, other data sources and consultation.

17.3.1 Vessel-to-Vessel Collisions – Change in Risk

The revised routeing pattern following construction of the wind farm has been estimated based on the review of impact on navigation (see Section 11.2). The main change is displacement of vessels which transit through the Project.

It is assumed that ships will revise their passage plans 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.

Based on vessel-to-vessel collision risk modelling of the revised traffic pattern, the collision risk was estimated to increase to 1 major collision in 50.8 years. The increase in collision frequency due to the Hywind Scotland Pilot Park Project was therefore estimated to be 1.5 x 10^{-4} per year, corresponding to one additional collision in 6,500 years.

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, or incidents occurring within port.

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

- Radar interference
- Visual obscuration when vessels approach each other.

The radar interference issue is discussed in Section 19. 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. AIS is not currently mandatory for smaller vessels, e.g., fishing vessels below 15m and recreational vessels, but this traffic is light in the area.

The visual issue is reviewed in Section 22.2 and is not considered a major factor for the Project site due to the size and position of the wind farm, which is in relatively open waters, as well as the turbine spacing of approximately 1370m.

17.3.2 Ship Collision with Structure

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

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

Each scenario is assessed below.

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

From consultation with the shipping industry, including the Marine Safety Forum which represents offshore industry vessel operators, it is assumed that merchant ships will not attempt to navigate between turbines due to the restricted sea room.

The main risk of powered collision with a wind farm structure is from human error on the bridge of the ship, e.g., watchkeeper asleep, absent or distracted. The proximity to port should mean mariners are more attentive to their vessel's position than in open seas although it was noted at the Hazard Review Workshop that outbound vessels leaving port will be beginning to stand down on the bridge, and the crew may be distracted by other tasks, such as paperwork. Inbound to Peterhead, there are likely to be "more eyes" on the bridge as the vessel prepares for arrival. This will vary for other destinations and departure ports such as Aberdeen.

Based on modelling the revised ship routeing pattern estimated with the Project structures in place and using local metocean data, the risk of a passing powered ship collision was estimated to be 1.2×10^{-4} per year (approximately 1 in 8,580 years).

This compares to the historical average of 5.3×10^{-4} per installation-year on the UKCS (1 in 1,900 years), covering both permanent platforms and temporary (mobile) drilling rigs. Therefore, the risk at Hywind is estimated to be slightly lower compared to the historical average. It is emphasised that this assumed effective circulation of information about the Project, such as to the Marine Safety Forum, to ensure Vessel Masters can revise their passage plans in advance of encountering the turbines.

<u>Drifting Ship Collision</u>
The risk of a ship losing power and drifting into a WTG Unit 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 site (up to 10nm from perimeter). These have been estimated based on the traffic levels and speeds identified from the surveys and the anticipated, revised routeing pattern following installation of the Hywind Scotland Pilot Park Project. 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 along with shipping industry breakdown rates, the overall rate of ship 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:

- Annual Wind Rose
- Peak Spring Flood Tide
- Peak Spring Ebb Tide

The worst-case result, used in this assessment, was generated based on ebb tide conditions.

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.

The annual drifting ship collision frequency with the WTG Units was estimated to be 9.4×10^{-6} per year corresponding to an average of one drifting ship collision in 106,700 years. The relatively low risk reflects the fact this is generally a low probability event. There have been no reported 'passing' drifting ship collisions with offshore installation 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'.

<u>Anchor Dragging / Drifting Collision with WTG Unit</u>
The survey data identified a small number of instances of anchoring to the western extent of the Pilot Park Study Area, in the vicinity of Peterhead.

Anatec's COLLRISK Anchor Dragging Risk Model was used to determine the frequency of a vessel dragging anchor and colliding with a WTG Unit. Calculations are performed within a GIS with relevant shipping and operational data (e.g. wind direction, sea-state etc.) as input.

The vessels anchoring in the region were identified from the AIS survey data and the area encompassing these vessels was divided into an exposure grid. The wind farm structures were also input. The frequency of vessels dragging anchor and colliding with a structure is equal to the frequency that vessels drag anchor from an exposure grid cell multiplied with the probability that a vessel drifts in the direction of a structure (based on wind and tidal direction probability) and the probability that the vessel fails to recover in time (based on the time to drift from the cell to the structure and the estimated time for ship recovery).

The frequency of a vessel dragging anchor and colliding with a WTG Unit was calculated to be minimal (less than 1×10^{-6} per year).

17.3.3 Fishing Vessel Collision

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

The two main inputs to the model are the fishing vessel density for the area, which has been conservatively estimated based on the sightings, satellite and traffic survey data analysis, and the wind farm structure details. It is assumed the fishing vessel density in the Buchan Deep area when the Project is operational will remain at the levels estimated from the baseline data. This is conservative as Statoil plan to apply for safety zones and/or a fishing prohibited area , hence fishing vessels may be displaced from the immediate vicinity of the wind park.

Using the above site-specific data as input to the model, the annual fishing vessel collision frequency with the WTG Units was estimated to be 2.9×10^{-4}, which corresponds to an average of one collision in 3,400 years.

17.3.4 Recreational Vessel Collision

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

1. Turbine Rotor Blade to Yacht Mast Collision
2. Vessel Collision with Main Structures

Both are considered to be low risk on the basis of the low levels of recreational traffic observed during the surveys and the consultation feedback from Peterhead Marina which indicated low numbers of yachts crossing the North Sea in the vicinity of Buchan Deep.

<u>Blade/Mast Collision:</u>
A collision between a turbine 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 turbines is 22m above all tidal states, given that the turbines float. This matches the MCA and RYA guidance.

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 17.4 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.

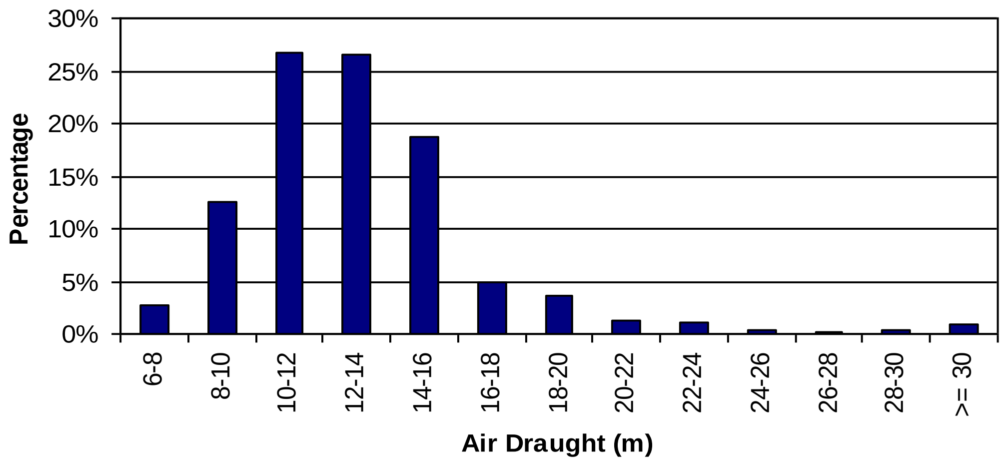


Figure 17.4 Air Draught Data – IRC Fleet (2002)

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 Maritime & Coastguard Agency in respect of control functions and safety features, as specified in the MCA standards (MCA, 2008a).

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 VHF, mobile phone, flares, etc. It is noted that very large yachts, which 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 above, the risk of dismasting of a yacht by a rotating blade of a Hywind Scotland Pilot Park Project WTG Unit 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 the majority of vessel movements occur 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 whilst they fix the problem or seek assistance.

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

The risk of small craft being in the area during bad 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 BBC and hourly by the Coastguard. It is also standard practice for harbours, marinas and clubs to post weather forecasts on notice boards.

Given the ready availability of weather forecasts and growing use of GPS, the risk of a vessel being in proximity to the wind farm in bad weather is considered to be low. This is supported by the traffic survey which indicated no recreational activity on AIS during autumn or winter. In the scenario of a vessel being out in bad weather, a vessel unable to make way from the wind farm and at risk of collision may alert the Coastguard using VHF or flares.

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 and IALA, 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 phases. Information will be circulated to yacht clubs, marinas and harbour masters at relevant ports, including Scandinavia.

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 turbines should be relatively low speed and hence low energy. If the seaworthiness of the recreational craft was threatened by the impact, the turbines will be equipped with access ladders for use in emergency, 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.

17.3.5 Other Hazards

The Hazard Review Workshop considered other hazards and ranked them using semi- risk matrices of frequency versus consequence. This included the following additional hazards:

- Fishing and anchor interaction with midwater mooring lines, power cables, anchors and cables;
- WTG total loss of station; and
- Work vessel collision with other vessel

This expert panel approach is considered appropriate for ranking these hazards rather than further quantitative modelling. The consensus was that all the hazards could be made broadly acceptable or tolerable (ALARP) using the available risk controls

It is noted that Statoil has commissioned a specialist quantitative modelling of mooring system failure to satisfy BP about the safety of the nearby Forties pipeline (DNV, 2014).

17.4 Future Case Level of Risk

17.4.1 Increases in Traffic Associated with Ports

Historical data for the UK indicates there has been a trend for larger vessels in the past 20-30 years but the number of movements has remained the same or reduced slightly.

The variation in ship arrivals handled at Aberdeen and Peterhead in recent years is presented in Figure 17.5, based on Department for Transport statistics[5]. It can be seen that there have been fluctuations over the period, but overall in 18 years the numbers of arrivals has decreased slightly. However, it is strongly emphasised that the DfT statistics do not fully record oil & gas, fishing or ferry traffic, which are the main constituents at both ports. Therefore, the chart is indicative of the general trend in merchant shipping only.

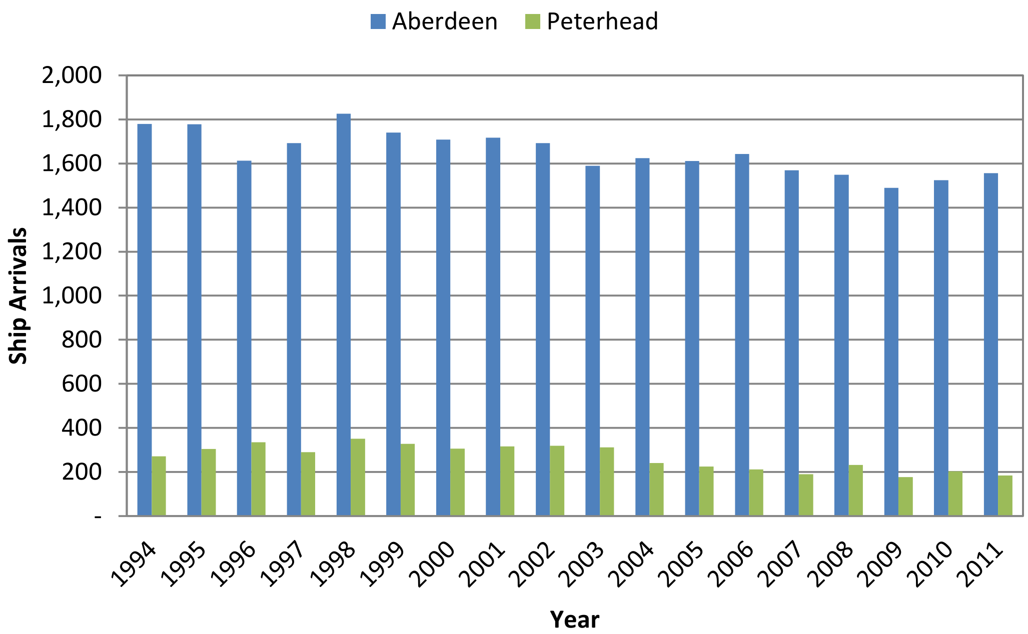


Figure 17.5 Ship Arrivals (1994 – 2011)

The figures below present shipping and traffic statistics published by Aberdeen Harbour for the last five years.

[5] The DfT statistics have some limitations in the vessels they cover but provide a good indication of the relative trend in traffic level.

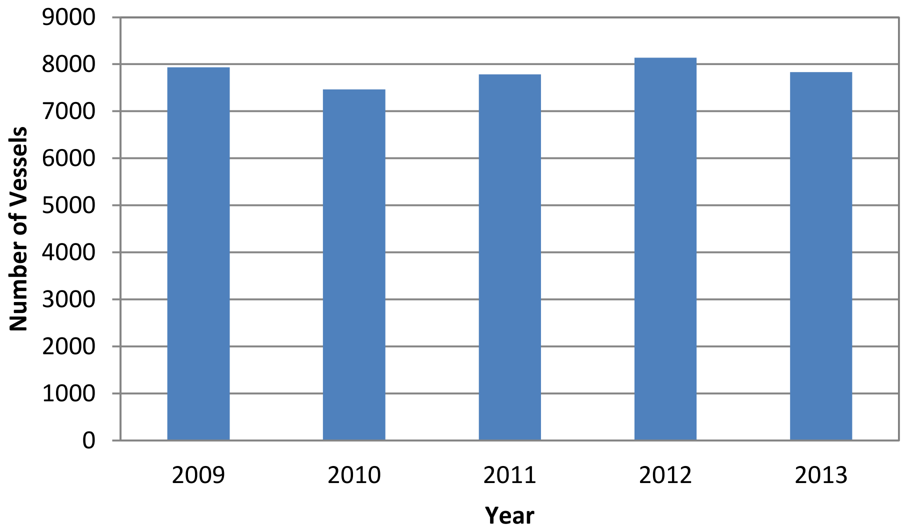


Figure 17.6 Number of Vessels at Aberdeen Harbour (2009-13)

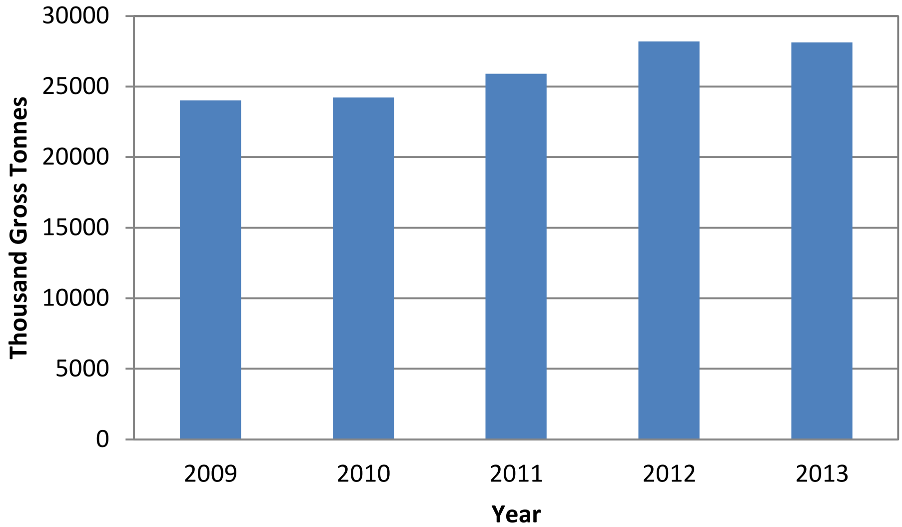


Figure 17.7 Tonnage of Vessels at Aberdeen Harbour (2009–13)

The number of vessels at Aberdeen Harbour has remained fairly constant, whereas the tonnage has increased by 17%. This indicates a trend towards increased tonnage being achieved by larger vessels rather than higher numbers of movements.

Aberdeen Harbour is currently investigating methods by which it can increase capacity within the Harbour, both in terms of volume and the need to accommodate increasingly large vessels. A site at Nigg Bay, just south of Aberdeen Harbour, has been identified as the preferred location for expansion.

Information published by Peterhead Port Authority indicates 2,501 vessels visited in 2008. The total gross tonnage of shipping handled in 2008 was 7.8 million. This has increased by

42% to 10.4 million in 2013. The increase is partly due to increased port calls by oil and gas logistics customers and larger size of subsea vessels.

Peterhead Port Authority has invested in the port in recent years. This includes opening the new all-weather deepwater Smith Embankment Quay in 2010, which can accommodate vessels up to 180m in length and has 10m depth. As well as traditional pelagic fishing, offshore oil & gas and commercial shipping, it is planned to attract business in the growing oil and gas decommissioning sector due to its heavy-lift capabilities. There are also plans to deepen the North and South Harbours and construct a new fish market.

Given the planned 20-25 years life of the Hywind development, and the uncertainty over future traffic predictions including oil & gas support traffic to the North Sea, a conservative potential growth in shipping movements of 10% has been assumed over the life of the wind farm.

17.4.2 Increases in Fishing Vessel Activity

Fishing activities are not consistent and vary year on year and therefore predictions on future changes are very difficult. In general, there has been a reduction in fishing effort in the past few decades due to changes in legislation, conservation schemes and decommissioning of the fleet.

For the purpose of the future case risk assessment, a 10% increase in fishing activity has been conservatively modelled.

17.4.3 Increases in Recreational Vessel Activity

In terms of recreational vessel activity, there are no major factors known to increase the activity of vessels at the site, but a 10% increase has been assumed to be conservative.

17.4.4 Collision Probabilities

The potential increase in traffic 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. Fishing activity and hence collision risk is also assumed to increase by 10%.

The increased shipping 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 fishing / recreation activity in the area may have an influence. In this case, the predicted collision frequency increase has been modelled with and without the wind farm based on the forecast traffic changes.

17.5 Risk Results Summary

The base case and future case annual levels of risk without and with Project site are summarised in Table 17.1 and Figure 17.8. The change in risk is also shown, i.e., the estimated collision risk with the wind farm minus the baseline collision risk without the wind farm (which is zero except for vessel-to-vessel collisions).

Table 17.1 Summary of Results

Collision Scenario	Base Case			Future Case		
	Without	With	Change	Without	With	Change
Passing Powered	--	1.17E-04	1.17E-04	--	1.28E-04	1.28E-04
Passing Drifting	--	9.37E-06	9.37E-06	--	1.03E-05	1.03E-05
Vessel-to-Vessel	1.95E-02	1.97E-02	1.55E-04	2.15E-02	2.17E-02	1.70E-04
Fishing	--	2.94E-04	2.94E-04	--	3.24E-04	3.24E-04
Total	1.95E-02	2.01E-02	5.75E-04	2.15E-02	2.21E-02	6.33E-04

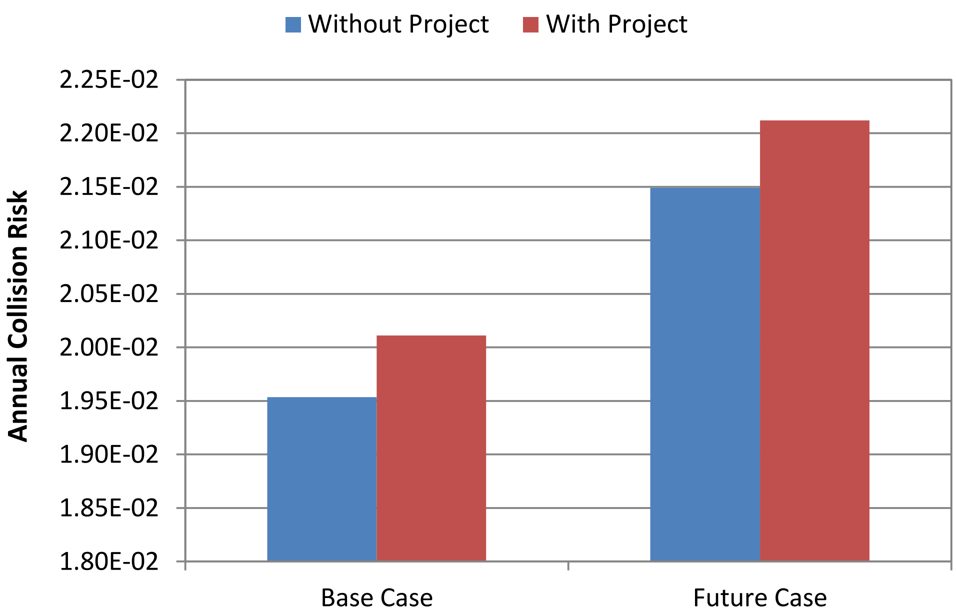


Figure 17.8 Summary of Results

The overall annual level of collision risk is estimated to increase due to the Hywind Scotland Pilot Park Project by approximately 1 in 1740 years (base case) and 1 in 1580 years (future case). Approximately half this risk is associated with fishing vessel collisions with the turbines.

17.6 Consequences

Within the hazard ranking process (see Section 16), the consequences of collision were ranked based on various criteria. The probable outcomes for the majority of hazards were expected to be minor. However, the worst case outcomes could be severe, including events with potentially multiple fatalities.

There has been a limited amount of structural modelling of ship collisions with fixed turbines using different sizes and speeds of ships. This has indicated that monopiles are likely to fail without significant damage to the ship (Dalhoff and Biehl, 2006). At a drifting velocity of 4 knots the section loads in nearly all considered parts exceeds the maximum loads of the wind turbines. Simulations of ship/turbine collisions at drifting velocities of 1, 2 and 4 knots indicated that the monopile would be pushed forward and will not fall towards the ship. Based on the research, monopiles foundations were considered to exhibit the lowest risk in case of collisions. Consequences to the ship could be more severe for steel tripods, jacket foundations and gravity based foundations.

In the case of floating turbines, the mooring system allows some movement therefore not all the collision energy will be absorbed by the structure and the ship. This is likely to mean less severe consequences in a collision compared to a fixed monopile. Breach of a ship's fuel tank is considered unlikely and in the case of vessels carrying hazardous cargoes, e.g., tanker, the additional safety features associated with these vessels would further mitigate the risk of pollution. Similarly, in a drifting collision the structure and moorings 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).

However, smaller vessels such as fishing vessels and recreational craft are more likely to suffer damage. 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 Project development is presented in Appendix B. This applies the site-specific collision frequency results presented above with estimated outcomes in terms of fatalities onboard and oil pollution from the vessel based on research into historical collision incidents (MAIB, ITOPF, etc.). The results are summarised in Table 17.2.

Table 17.2 Annual Predicted Change in Collision Risk due to Hywind Scotland Pilot Park Project

Criteria	Base Case	Future Case
Potential Loss of Life (PLL)	1 fatality in 74,000 years	1 in 67,000 years
Oil Spill	0.0040 tonnes	0.0044 tonnes

Comparing the above estimates with the background marine accident risk levels in the UK, the incremental increase in risk to both people and the environment caused by the Project development was estimated to be minimal.

It should be noted that this is the localised impact of a single project and there are additional maritime risks associated with other offshore wind farm projects in the North Sea as well as in the UK as a whole. This is discussed further in Section 20.

18. CONSTRUCTION AND DECOMMISSIONING IMPACTS

18.1 Introduction

This study has focused primarily on the operational phase of the Hywind Scotland Pilot Park Project, however, it is recognised that there will be additional temporary impacts during the construction and decommissioning phases, and to a lesser extent maintenance.

In general, whilst the same hazards apply as during operation, there are additional hazards which are distinctly associated with these phases of the development and require different risk control measures. This section presents some further qualitative review of these activities. (The key risks have been assessed within the Hazard Review Workshop – see Appendix A.)

18.2 Construction, Maintenance and Decommissioning

During the construction / maintenance / decommissioning phases there will be an increased level of vessel activity within the Hywind Scotland Pilot Park Project site, to and from the base port(s) and along the cable route.

An example of the potential vessel activity during construction and maintenance is listed in Table 18.1.

Table 18.1 Vessel Numbers during Construction / Maintenance

Project Phase	Activity	Vessels	Maximum Duration
Construction	Anchor and mooring installation	1 anchor handling vessel and 1 light subsea construction vessel	8h per anchor, 2-3 week duration Anchors and lower mooring installed 4 weeks-1 year before installation of WTG Units
	Inter-array cable installation	1 installation vessel and 1 crew transfer vessel	10-15 days
	Hook-up and mooring of WTG Units	1 light subsea construction vessel and 1 crew transfer vessel	24h per WTG Unit, 1 week duration
	Export cable installation	1 cable lay vessel and 1 trenching vessel	5-8 days installation
	Export cable trenching	1 cable trenching vessel	8-12 days
Maintenance	Export cable inspection	Supply vessel with ROV	Inspection every 1-4 years 1-4 days per

Project Phase	Activity	Vessels	Maximum Duration
			inspection
	WTG Units	1 crew transfer vessel	Annual service 50-70h per year
	Substructure, moorings and inter-array cables	1 crew transfer vessel and 1 supply vessel with ROV	Inspection every 1-4 years 1 day duration
	Unforeseen visits		10 per WTG Unit per year for corrective actions 25-100 days per year

During the decommissioning phase, WTG Units, mooring lines, anchors and on-surface inter-array cables will be removed and will follow the same relative sequence as construction. The mooring lines will be disconnected and the anchors removed from the seafloor. The WTG Units will be towed back to a nearshore location, where they will be dismantled. The inter-array cables (unless buried) will be removed, while the offshore export cable is anticipated to be abandoned in place after decommissioning. It is anticipated that all objects abandoned on the seabed will be cut below mud-line or covered so as not to pose a hazard to navigation. Vessel numbers potentially present during the decommissioning phase have not yet been estimated.

The presence of work vessels in the area is likely to pose an additional navigational risk, although such vessels can also provide on-site response and mitigation, e.g., a vessel will be nominated as a guard vessel.

The main navigational hazard associated with these phases of the Hywind Scotland Pilot Park Project which have been identified over and above those associated with all phases (i.e., where the same risk control measures and emergency response will apply during all phases) is work vessel collision with another vessel, which could either be another Project vessel or a passing vessel, or with a turbine.

To date, there have been relatively few such incidents and the consequences have been minor, mainly resulting in minor damage to vessels and injuries to personnel. A detailed review of the available data is presented in Appendix D. Statoil, as members of the G9 Offshore Wind Health and Safety Association, have been pro-active in sharing incident data and lessons learned within the offshore wind industry.

In terms of 3rd party impacts, a guard vessel will be used to mitigate the risks and increase awareness during the early stages of the Project. Safety zones during construction are industry-standard to protect installation vessels and their personnel, as discussed in Section 21.

Details of risk control / mitigation measures which will apply during these phases of the work are included in Section 23.

The construction company appointed will have their own internal health and safety procedures that they will adhere to during the work, providing additional security.

18.3 Activity before WTG Unit Installation

Mooring lines and anchors will be installed in the Pilot Park at least four weeks (and possibly up to one year) before installation of the WTG units depending on timescales and suppliers. This was identified as a potential hazard to fishing vessels at the Hazard Review Workshop as the anchor and lines will be on the seabed before any surface structures are visible.

Various potential mitigation measures have been identified including use of a guard vessel, a physical marker as well as circulation of information in advance of installation via Notices to Mariners, fisheries liaison, etc.

The export cable will also be installed prior to the WTG Units and there may be a delay between installation and protection being put in place. Again, measures such as a guard vessel would be suitable to protect the cable during this period.

18.4 Turbine Towage Operation

The turbines will be towed from an assembly site (currently unknown) to Buchan Deep. This operation was highlighted within meetings with the MCA and NLB, and at the Hazard Review Workshop, as needing additional consideration given the likely distance from the assembly point to the Buchan Deep site and the maritime risks during towage, e.g., collision, adverse weather and grounding. Specific risk control measures will also need to be identified for this operation.

It is planned that the towage operation will be subject to a separate detailed review once full details are known, and further consultation will be carried out at that time.

19. IMPACT ON MARINE RADAR SYSTEMS

19.1 Introduction

In 2004 the MCA conducted trials at the North Hoyle wind farm off North Wales to determine any impact of wind turbines on marine communications and navigation systems (MCA & QinetiQ, 2004).

The trials indicated that there is minimal impact on VHF radio, Global Positioning Systems (GPS) receivers, cellular telephones and AIS. UHF and other microwave systems suffered from the normal masking effect when turbines 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 wind turbine 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 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 2.2) to give guidance on the distances which should be established between shipping routes and offshore wind farms. The onset range from the turbines of false returns is about 1.5nm, with progressive deterioration in the radar display as the range closes.

A second trial was conducted at Kentish Flats on behalf of BWEA (BWEA, 2007). The project steering group had members from the BERR, the MCA and the Port of London Authority (PLA). The trial took place between 30 April and 27 June 2006. This trial was conducted in Pilotage waters and in an area covered by the PLA Vessel Traffic Service (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.
- 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.

This section reviews these issues relative to the Project both in isolation and in combination with other wind farms planned nearby.

19.2 Hywind Scotland Pilot Park Project Site-Specific Radar Impact

Figure 19.1 presents 28 days of spring 2014 AIS data relative to the Hywind Scotland Pilot Park Project WTG Unit locations, with the WTG Units buffered by 500m, 1.5nm and 2nm.

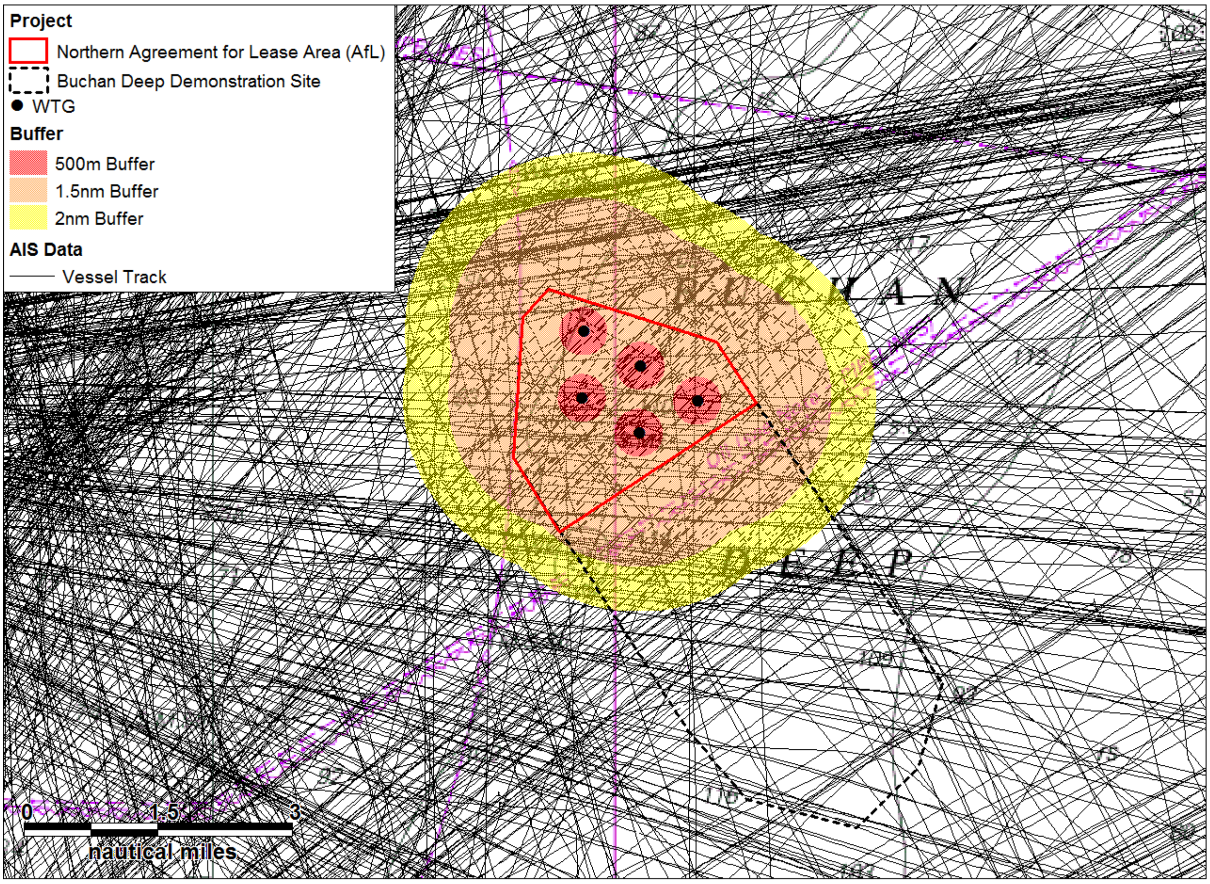


Figure 19.1 Hywind Scotland Pilot Park Project WTG Units with 500m, 1.5nm and 2nm Buffer Zones verses Spring 2014 AIS Data

Traffic currently passing through the Hywind Scotland Pilot Park Project is likely to re-route to the north and south of the Project, with most expected to maintain a minimum clearance of 1nm. The radar effects described are only likely to be experienced within 1.5nm of the WTG Units.

The effects will be less severe than other offshore wind farms in the UK due to there being only five structures.

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. AIS will also help to determine if a target is valid, as most vessels in this area mandatorily carry AIS.

Experienced mariners should be able to suppress the observed problems to an extent and for short periods by careful adjustment of the receiver amplification (gain), sea clutter and range settings of the radar. However, there is a consequent 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 (MCA, 2008b).

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 Hywind Scotland Pilot Park Project. 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.

Although the evidence from mariners operating in the vicinity of existing wind farms is that they learn to work with and around the effects, there is potential for radar impacts to increase the risk of collision. The MCA have produced guidance to mariners operating in the vicinity of UK OREIs which highlights this issue amongst others to be taken into account when planning and undertaking voyages in the vicinity of OREIs off the UK coast (MCA, 2008b).

Due to there being only five structures present at the Hywind Scotland Pilot Park Project with a limited footprint, and given the high standard of the majority of the passing shipping, it is not anticipated that radar effects will be significant.

20. CUMULATIVE AND IN-COMBINATION EFFECTS

20.1 Introduction

Details of the cumulative and in-combination projects to be considered in the impact assessment were provided by Xodus. This list of projects has been assessed to determine the main cumulative and in-combination effects to shipping and navigation in the vicinity of the Hywind Scotland Pilot Park Project.

- **Cumulative effects** - refers to impacts on shipping and navigation arising from all the planned and consented UK offshore wind farms (and their associated activities) including those in EU Member State waters.

- **In-combination effects** - refers to impacts on shipping and navigation arising from offshore wind farms (and their associated activities) combined together with impacts from other marine activities or uses of the sea (TCE, 2012).

20.2 Cumulative Effects

Cumulative effects are impacts on shipping and navigation caused by planned and consented offshore wind farms. Figure 20.1 presents other offshore wind farm developments in the vicinity of the Hywind Scotland Pilot Park Project and Table 20.1 presents a list of these projects and their details.

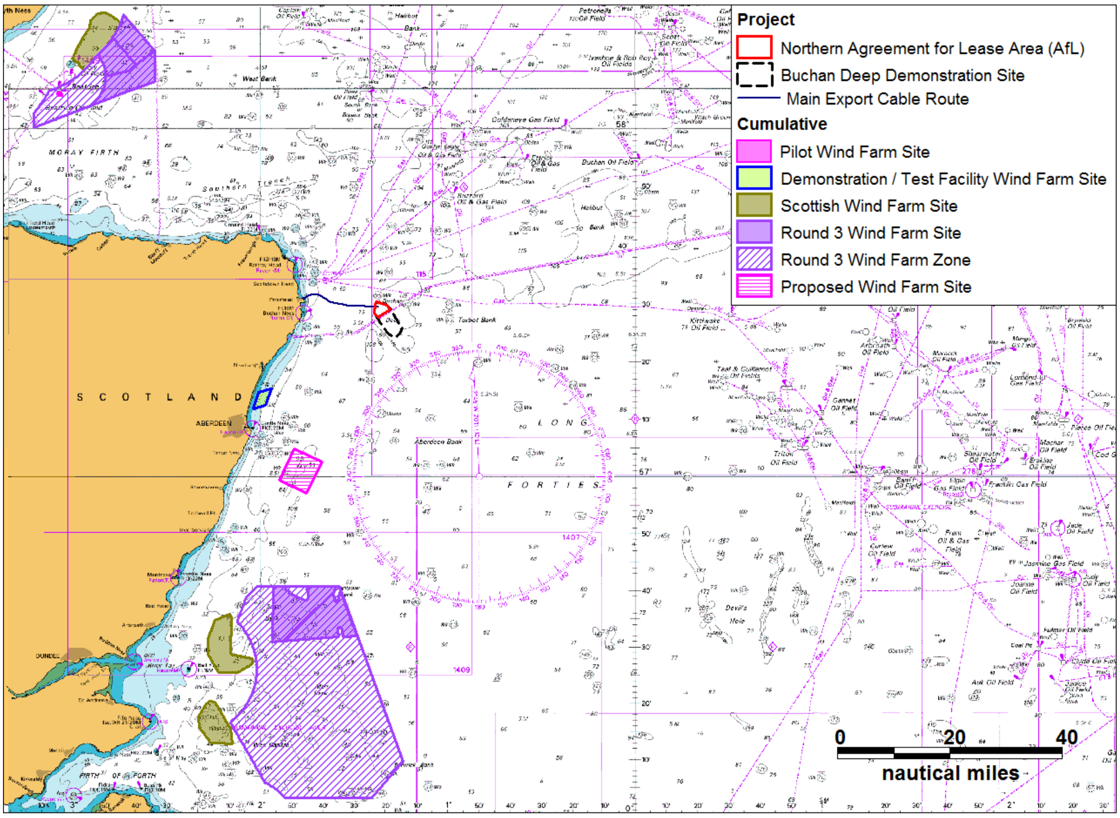


Figure 20.1 Offshore Wind Projects Considered in Cumulative Assessment

Table 20.1 Cumulative Projects

Project Name	Distance from Pilot Park (nm)	Project Developer	Description	Status	Screened In
EOWDC	20	AOWFL	Turbine deployment centre. 11 turbines with up to 100 MW capacity.	Consented	No
Kincardine Offshore Wind Farm	25	Kincardine Offshore Wind Farm Ltd.	Commercial demonstrator site. Floating semi-submersible technology. 8 turbines.	EIA Scoping Report submitted April 2014.	No
Firth of Forth Offshore Wind Farm	45	Seagreen Wind Energy Ltd.	Offshore wind farm to be developed in 3 Phases. Total target capacity of 3.5 GW.	Phase 1 – offshore EIA submitted. Phase 2 & 3 – EIA Scoping opinion issued.	No
Moray Offshore Renewables Wind Farm (eastern development area)	53	Moray Offshore Renewables Ltd (MORL)	1,500 MW wind farm.	EIA submitted. Construction planned to begin Q3 2015 to full generation in Q3 2020.	No
Inch Cape Offshore Wind Farm	56	Inch Cape Offshore Wind Farm Ltd	1,000 MW wind farm up to 213 turbines.	Offshore consent application (with EIA) submitted July 2013.	No
Beatrice Offshore Wind Farm Demonstrator Project	64	SSE and Talisman	2 turbine 10 MW demonstrator project.	Operational.	No
Beatrice Offshore Windfarm Ltd (BOWL)	64	SSE	Maximum 227 turbines, up to 1,000 MW.	Offshore EIA addendum submitted May 2013 for the wind farm.	No

Project Name	Distance from Pilot Park (nm)	Project Developer	Description	Status	Screened In
Neart na Gaoithe Offshore Wind Farm	71	Mainstream Renewable Power	75- 125 turbines, 450 MW.	EIA submitted March 2013. Offshore construction in 2015 subject to consent.	No
Fife Energy Park Offshore Demonstration Wind Turbine	92	Fife Energy Park	Single offshore turbine	Consented.	No

These developments are all in excess of 10nm from the Hywind Scotland Pilot Park Project and it is anticipated that these will not have a cumulative impact on shipping and navigation when considered with the Project.

It is noted that a proportion of the ships passing the Hywind Project also pass close to the planned EOWDC site in Aberdeen Bay. However, this site layout has been designed to avoid any significant impact on the main shipping routes to and from Aberdeen Harbour.

20.3 In-Combination Effects

In-combination effects are impacts on shipping and navigation as a result of offshore wind farms (and their associated activities) combined together with impacts from other marine activities or uses of the sea.

Following assessment of the baseline, it has been identified that the development of the Hywind Scotland Pilot Park Project may have in-combination effects with the navigational activity of other receptors. The following receptors have been identified which have the potential to create in-combination effects.

- Commercial shipping;
- Commercial fishing
- Recreational craft;
- Oil and gas developments;
- Port operations; and
- MOD – Practice and Exercise Areas.

Vessel transits were considered in detail as part of the baseline for the NRA, therefore vessel traffic associated with the above has effectively been screened out of the in-combination section (as it has have already been taken into account in the project specific NRA) and is not further considered within this assessment.

Table 20.2 presents a list of the developments in the vicinity of the Hywind Scotland Pilot Park Project which have been identified as having the potential to impact on shipping and navigation.

Table 20.2 In-Combination Projects

Project Name	Distance from Pilot Park (nm)	Project Developer	Description	Status	Screened In
NorthConnect Interconnector	0-30 (depending on cable route)	NorthConnect	Onshore component of NorthConnect Project for HVDC cable between Norway and UK. Erection of converter station, underground cabling and association infrastructure and improvement works.	Submission of proposal application notice.	No
Eastern HVDC Link	0-30 (depending on cable route)	SSE and National Grid Electricity Transmission	Upgrade of existing infrastructure in Peterhead (upgrade of existing HDVC converter station at existing power station) and installation of a subsea HDVC cable from Peterhead to Teesside. Project delivery expected 2017 / 2018.	EIA Scoping Opinion issued for marine works.	No
Aberdeen Harbour Development, Nigg Bay	20	Aberdeen Harbour Boards	Development would occupy a large area of Nigg Bay, comprising approximately 1400 m of new quays (13-14 new berths).	EIA Scoping Opinion issued.	No

Project Name	Distance from Pilot Park (nm)	Project Developer	Description	Status	Screened In
Offshore Renewables Masterplan, Whiteness Head, Ardersier	> 50	The Port of Ardersier Limited	Establishment of a port and port services for energy related uses. Proposal includes channel dredging, quay realignment, repair and maintenance, offices, industrial and storage buildings and associated new road access, infrastructure and services in a 307 ha area of land.	Revised ES submitted October 2013.	No
Invergordon Service Base 3 Development	> 50	Cromarty Firth Port Authority	Extension of 3 piers to provide new berths, and laydown areas. Includes a reclaimed laydown area of 3.48 ha.	Consented.	No

Future traffic considered in the NRA partly takes into account potential increases changes in traffic such as over the life of the development due to changes such as the Aberdeen Harbour Development, North Sea oil and gas decommissioning and temporary traffic for subsea cable installation and maintenance. It is recognised that making such future forecasts is uncertain therefore a conservative 10% increase was modelled. It is not considered that there will be any further in-combination impact on shipping and navigation when considered with the Project.

21. SAFETY ZONES

21.1 Introduction

Safety zones for renewables projects are normally applied for post-Consent and pre-Construction based on the information in the Navigation Risk Assessment and consultation with DECC, the MCA, the General Lighthouse Authority and other stakeholders, as appropriate.

In the case of Hywind, Statoil have had discussions with DECC and the MCA during the NRA process about the potential use of Safety Zones, or other forms of mitigating measures, to reduce the risk to vessels and the Project by excluding activity which could pose a maritime hazard. These talks are summarised in Section 15 and further dialogue is planned prior to submission of the Safety Zone application to DECC.

This section presents details on standard industry practice followed by a summary of the discussions that have taken place about the Hywind Project to date, and the potential impact of the measures being considered.

21.2 Standard Industry Practice

21.2.1 Construction and Decommissioning Phases

During these phases of the development there will be large construction vessels, working personnel and support craft, e.g., tugs and crew transfer vessels, in operation within and around the wind park. These types of operations have inherent dangers to the personnel involved and good practice is to minimise the hazards and the exposure time. In addition the cost of operating construction vessels, and the cost of delay 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 the offshore operations in a controlled manner. To ensure the personnel carrying out these activities and those navigating in the sea area are not exposed to unnecessary risk, it is standard industry practice for 500m rolling safety zones to be applied for during these phases of the development. This provides a means of regulating the rights of navigation to preserve the safety of those working in the wind farm and those onboard other vessels that may be navigating in this area.

Procedures for policing the zones are required, such as traffic monitoring, to detect potential collision threats and/or safety zone infringements. A vessel is usually nominated as a guard vessel during these activities and given primary responsibility for policing the safety zone. Procedures are also in place to ensure that any infringements are formally reported in-line with the regulatory requirements.

21.2.2 Operational Phase

During normal operations, working activities are generally limited to routine and emergency maintenance work and as such the benefits and requirements for safety zones are normally reassessed giving account to the working vessels likely to be present within and around the wind farm. These vessels will generally be smaller than those involved in the construction phase of the project.

The vast majority of wind farms in the UK have no safety zones during normal operation, with one exception at Greater Gabbard, east of Harwich, which has 50m radii zones. However, there has been a move towards advisory 50m zones around turbines.

21.3 Hywind Project

21.3.1 Overview

Unlike a traditional wind farm in the UK, the Hywind Project will comprise of floating turbines and their moorings, with the three mooring lines radiating out from each turbine to approximately 750m where they are anchored to the seabed using suction anchors that protrude above the seabed. The mooring lines and anchors pose minimal risk to surface navigation but could be a potential snagging hazard to fishing gear as well as vessel anchoring.

This issue has been discussed with the MCA at meetings in July and November 2013 and with DECC in June 2014. Statoil would prefer to permanently exclude fishing and anchoring activities that could pose a hazard to mariners as well as potentially damage assets, as is done at the Hywind site in Norway. However, it is not clear if this can be achieved in UK waters. The three main options that have been discussed are:

- Safety Zones of up to 500m radii around turbines with advisory zones beyond this covering the subsea elements.
- Area To Be Avoided (ATBA) covering the whole site but only applying to specific activities, i.e., fishing and anchoring.
- Fishing Prohibited Area.

In terms of policing, monitoring of the zones would take place using AIS, which covers the vast majority of vessels that are operating in the area. Evidence of deliberate infringements would be reported to the appropriate authorities for follow-up action.

More discussions are planned, and ultimately any measures would require a risk-based justification before being adopted. To assist with this process, further discussion is provided below based on the NRA and in particular the Hazard Review Workshop feedback.

21.3.2 Construction and Decommissioning Phases

During this phase it is envisaged that rolling safety zones of 500m will be needed to protect the construction activities from third-party passing vessels, as is the current industry standard. Statoil also intend to apply for safety zones around each WTG Unit once installed until the construction phase has ended. It is likely that WTG Units will be installed in Q2 or Q3 of 2017, with installation lasting 20 days. Final commissioning of WTG Units will be completed by Q4 2017.

This will have a temporary, localised impact on vessel navigation but, given the sea room available surrounding the area, this is not considered to be significant. A guard vessel would be at the site during the construction activity to police safety zones.

However, it is planned that the mooring lines and anchors are installed in the first year and left on the sea bed prior to the floating turbines being installed the following year. These could pose a snagging hazard to demersal fishing which takes place in Buchan Deep. This was discussed at the Hazard Review Workshop and safety zones were considered essential by several of the attendees to mitigate the risk to fishing vessels. However, fishermen and industry representative present felt they could manage the risks themselves provided they were supplied with accurate information on the positions of the hazards on the sea bed. There are standard measures to achieve this such as FishSafe devices and chart plotters, and it was noted most of the vessels fishing in the area are Scottish. It was also suggested that a guard vessel should remain on site during the interim period between mooring system and turbine installation to warn fishing vessels of the potential danger. NLB suggested a temporary buoy could be deployed as a physical marker.

21.3.3 Operational Phase

Considering the surface elements, i.e., the turbines, there is a mechanism via DECC to achieve safety zones of up to 500m, which provides a safety buffer to help protect against transiting traffic collision, if justification can be provided. Statoil have identified a large vessel collision as a hazard which could lead to mooring system failure and potentially damage the BP Forties pipeline (DNV, 2014).

It is considered unlikely that the merchant shipping identified in the maritime traffic survey, such as the oil & gas support traffic, would choose to pass within 500m of the Hywind turbines. This was the view of the ASCO and Marine Safety Forum representative, who indicated that such vessels based on the East Coast (Peterhead and Aberdeen) are used to avoiding offshore installations by 500m due to their oil & gas activities. There is ample sea room available surrounding the Pilot Park for these vessels to achieve this clearance with minimal deviation to their current passages.

Recreational traffic has been confirmed to be very light in this area, based on stakeholder consultation supported by RYA Coastal Atlas and AIS data. Only a small number of vessels crossing between Scotland and Scandinavia are likely to pass near the site, estimated at 20-30 per year. Therefore, safety zones will not have a major impact on this type of traffic.

Fishing vessels when steaming on passage, such as when working as guard vessels for the oil & gas industry or when heading to and from fishing grounds, can be treated the same as merchant traffic and therefore the impact of safety zones around the turbines is also considered to be minimal.

However, when vessels are fishing in the area, the industry representatives consulted indicated they want the option to fish as close as they safely can to the turbines, as well as the mooring lines and anchors. In the absence of safety zones or another form of exclusion, this would be left to individual skippers to decide, taking into account the prevailing weather and sea conditions. Non-fishing industry attendees at the workshop considered safety zones around the subsea elements to be a sensible precaution to protect against potential unsafe practises or human error. The fishing industry attendees prefer to manage the risk themselves rather than enforcement, with measures to assist them in this including FishSafe units which alarm when vessels are close to hazards.

Statoil intend to carry out further consultation with the MCA, DECC and Marine Scotland regarding safety zones, or other methods of protecting against collision and fishing gear interaction during the operational phase. The agreed strategy, whether mandatory or advisory, will be implemented and notified to UKHO for suitable depiction on Admiralty charts.

22. ADDITIONAL NAVIGATION ISSUES

22.1 Introduction

There are a number of additional navigational issues identified within MGN 371 (MCA, 2008a) which require to be addressed by the developer. The following subsections cover additional navigation related issues which have not been covered elsewhere within this report.

22.2 Visual Navigation and Collision Avoidance

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.

The Hywind Scotland Pilot Park Project occupies a relatively small overall footprint area of approximately 5km^2 and there will be only five structures present, with minimum spacing of approximately 1,370m. The Project is located in relatively open waters away from the coastline and other navigational features / hazards. Therefore, the visual impact increase in terms of potential increase collision risk to shipping is estimated to be minimal.

22.3 Potential Effects on Waves and Tidal Currents

The specialist coastal processes study carried out as part of the ES concluded that the impact of the Project on the wave and current regime will be negligible (Chapter 8: Physical environment).

22.4 Impacts of Structures on Wind Masking/Turbulence or Sheer

The offshore turbines 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 turbines do reduce wind velocity by in the order of 10% downwind of a turbine. The temporary effect is not considered as being significant and 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 sites indicates that this is not likely to be an issue.

22.5 Sedimentation/Scouring Impacting Navigable Water Depths in Area

There exists the potential for structures in the tidal stream to produce siltation, deposition of sediment or scouring which could affect the navigable water depths in the wind farm area or adjacent to the area. There are expected to be no impacts on the marine physical environment associated with the Hywind Project (Chapter 8: Physical environment).

22.6 Structures and Generators affecting Sonar Systems in Area

No evidence has been found to date with regard to existing 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 Project.

22.7 Electromagnetic Interference on Navigation Equipment

Based on the findings of the trials at the North Hoyle Offshore Wind Farm (MCA & QinetiQ, 2004), the wind farm generators and their cabling, inter-turbine and onshore, 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 turbines. 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 (where practicable) and any generated fields are expected to be very weak and will have no significant impact on navigation or electronic equipment.

22.8 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 and experience of personnel/vessels operating in and around other offshore wind farm sites.

22.8.2 VHF Communications (including Digital Selective Calling)

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

22.8.3 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 Project site.

22.8.4 VHF Direction Finding

During the North Hoyle trials, the VHF direction equipment carried in the lifeboats did not function correctly when very close to turbines (within about 50 metres). This is deemed to be a relatively small scale impact and provided the effect is recognised, it should not be a problem in practical search and rescue.

22.8.5 Automatic Identification Systems

In theory there could be interference when there is a structure located between the transmitting and receiving antennas (i.e., blocking line of sight). This was not evident in the trials carried out at the North Hoyle site and no significant impact is anticipated for AIS signals being transmitted and received at the Project site, especially as there are only five turbines.

22.8.6 Global Positioning Systems

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

22.8.7 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 0.25 nautical miles. Its use is in steep decline, with GPS being the primary replacement. It is mostly used in ships on and near the US coast, although some GPS receivers have built-in Loran-C software.

Attempts were made to test a system during the North Hoyle 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 Project development is 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.

22.9 Noise Impact

22.9.1 Acoustic Noise Masking Sound Signals

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

The 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 decibels (dB) and be audible at a range of 1.5nm. Therefore, this should be heard above the background noise of the wind farm. Foghorns will also be audible over the background noise of the wind farm.

Therefore, there is no evidence that the sound level of the wind farm will have any significant influence on marine safety.

22.9.2 Noise Impacting Sonar

Once in operation it is not believed that the subsea acoustic noise generated by the wind farm will have any significant impact on sonar systems.

23. RISK MITIGATION MEASURES & MONITORING

23.1 Mitigation Measures

This section summarises the risk mitigation measures which are planned for the Hywind Scotland Pilot Park Project.

This is divided into standard industry practice measures listed in Table 23.1, which are generally carried out for any UK wind farm, and additional, Project-specific (enhanced) mitigation measures which have been identified during the course of the NRA, listed in Table 23.2, which have been identified during consultation and from suggestions made at the Hazard Review Workshop (see Appendix A). It is noted that consultation on mitigation measures will continue with the MCA, NLB, Marine Scotland and other relevant stakeholders post-application to agree the final details.

Table 23.1 Standard Industry Practice

Standard Industry Practice
Adverse Weather: There will be adverse weather working policies and procedures for periods of construction and maintenance.
Cable Protection: Appropriate cable protection to be installed along the cable route, informed by a BPI study which will be submitted to the MCA prior to installation.
Chart Marking: The Project will be depicted on Admiralty Charts produced by the UKHO.
Emergency Response Cooperation Plan: An ERCoP will be prepared for the Project following the template provided by the MCA in MGN 371. This will be submitted to the MCA for approval prior to construction.
Equipment and Training for Site Personnel: Site personnel will be suitably equipped and trained for work offshore including in fire fighting, first aid and offshore survival.
Fisheries Liaison: The FLOWW (Fishing Liaison with Offshore Wind and Wet Renewables Group) best practice guidance for fisheries liaison will be followed, including the establishment of a fishing liaison plan. An FLO has been appointed for the Project and will continue in this role during construction.
Guard Vessel during Construction: When there are work vessel(s) on site, one vessel will be nominated as a guard vessel with appropriate procedures for traffic monitoring and collision risk management.
Inspection and Maintenance: There will be appropriate inspection and maintenance procedures in place for all elements of the Project.
Kingfisher Charts and FishSAFE: Details of the Project will be included in updated Kingfisher fishermen's awareness charts (paper and electronic) and on FishSAFE electronic safety devices which give and audible alarm when vessels are close to hazards.
Maritime Safety Information (MSI) Broadcasts: HM Coastguard will be informed of work at the site to allow them to issue MSI broadcasts as appropriate.
Marking and Lighting: The Project will be marked and lit according to NLB requirements.
Minimum Air Clearance: There will be a minimum air clearance of 22m from sea level in all tidal states due to the floating nature of the turbines. This is desgined to help minimise

Standard Industry Practice
the risk of rotor blade / yacht mast interaction in accordance with MCA and RYA guidance.
Notice to Mariners: Notices to Mariners will be issued prior to the start of construction and where necessary during work at the site.
Safety Management System (SMS): Statoil will have in place an SMS throughout the project.
Safety Zones during Construction: Safety zones of 500m radii will be applied to protect working vessels on the site during construction work.

Table 23.2 Project Specific (Enhanced) Mitigation Measures

Project Specific (Enhanced) Mitigation Measures
AIS Traffic Monitoring: Live 24/7 shipping traffic monitoring on AIS by Statoil Marine in Bergen during the operational phase with procedures to follow in the event a vessel is identified to be heading on a potential collision course.
AIS on Work Vessels: All vessels working at the site will broadcast on AIS.
Excursion Alarm: The positions of the WTG Units will be monitored with an automatic emergency alarm to notify excursion from the central location.
Lessons Learned: Experience and lessons learned from incidents, accidents and near-misses at other marine renewables projects will be taken into account. Statoil is a member of the G9 Offshore Wind Health and Safety Association, and is proactive in sharing incident data and lessons learned within the offshore wind industry. The Project will also benefit from experience gained at the Hywind Demo Project in Norway which has been operational since 2009.
Mooring System Integrity: Speciality study carried out to examine in detail the risk of mooring system failure leading to impairment of the BP Forties Pipeline.
Passage Plans for Construction Vessels: Passage plans will be developed for vessels routeing between the Project and the onshore base.
Operational Safety Zones: Further consultation will be carried out with the MCA and DECC regarding safety zones, or other methods of protecting against collision and fishing gear interaction during the operational phase. The agreed strategy, whether mandatory or advisory, will be implemented and notified to UKHO for suitable depiction on Admiralty charts.
Safety Zones during Construction: Additional safety zones of up to 500m radii will be applied for around each WTG Unit once installed until the construction phase at the site has ended.
Sailing Directions and Almanacs: Details of the Project will be circulated to relevant organisations for inclusion in updated Sailing Directions and Almanacs.
Targeted Circulation of Information: Information on the Project will be circulated directly to local ports, ship operators (including the Marine Safety Forum representing oil industry vessels), fishermen and recreational organisations (including relevant international organisations).

Project Specific (Enhanced) Mitigation Measures
Temporary Guard Vessel and/or Buoyage: Guard vessel and/or temporary buoyage to be considered in the period between installation of the mooring lines and anchors and WTG units being installed (approximately 9-12 months) to provide a physical indication of their presence.
Third Party Verification of Mooring System: Design and third party verification of the mooring system will be carried out by a competent organisation.
Towing Vessel Availability: The Project is located in an area of above average towing vessel activity due to the oil and gas industry bases at Peterhead and Aberdeen. This will be given consideration within the ERCoP to ensure benefit is obtained in the event of a drifting scenario.

23.2 Future Monitoring

Real-time AIS traffic monitoring will be carried out of the Project area with the locally collected data being fed back to Statoil's onshore control room in Bergen. This will assist in the control of work vessels and emergency response. The data can also be used to identify any vessels infringing safety zones (if established) or operating in a hazardous manner, and provide evidence which can be passed to the MCA for follow-up action (if appropriate).

24. CONCLUSIONS AND RECOMMENDATIONS

24.1 Conclusions

A Navigation Risk Assessment for the Hywind Scotland Pilot Park project has been carried out following the MCA and DECC Guidance for such assessments.

This included extensive baseline data collection to obtain information on the vessel activities in the vicinity of the Project, comprising seasonal AIS data, visual surveys, desk-based information and consultation with local stakeholders / experts.

This identified that the area is used by transiting merchant vessels, with around two-thirds associated with the oil & gas industry. The majority of these are using the onshore bases at Peterhead Port and Aberdeen Harbour. There is also fishing vessels activity in Buchan Deep, both from vessels steaming on passage and vessels engaged in fishing, such as trawling. There is limited recreational vessel activity in the vicinity of the Project due to its offshore location outside UK territorial waters. However, there are occasional transits by yachts crossing the North Sea which pass in the vicinity.

The potential hazards to this vessel activity posed by the Project have been assessed based on consultation, a Hazard Review Workshop involving a cross-section of local stakeholders and quantitative risk modelling. Based on this assessment it is considered that the risks are broadly acceptable or tolerable with appropriate mitigation. Details on the planned control measures are listed in this report.

Further consultation with regulator and stakeholders, will be carried out to agree the details of the measures that will be implemented, such as safety zones and marking, to ensure the mitigation is effective and the final project is ALARP.

Other areas highlighted for further work at the appropriate time are as follows:

- Burial Protection Index study of the export cable
- Risk review of turbine towage operation from assembly site
- Marking and lighting (to be agreed with NLB)
- Emergency Response Cooperation Plan (to be approved by the MCA) (It has been requested by Marine Scotland that a draft ERCoP be submitted with the Marine Licence application)
- Plan for widespread information circulation about the Project
- Real-time traffic monitoring via AIS

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Hazard Review Workshop Report

Hywind Scotland
Pilot Park Project
(Appendix A)

Prepared by:	Anatec Limited
Presented to:	Xodus Group Limited on behalf of Hywind Scotland Limited
Date:	25 November 2014
Revision No.:	02
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1. Introduction

This appendix summarises the main points from the Hywind Scotland Pilot Park Project (to be developed by Hywind Scotland Limited (HSL)) Hazard Review Workshop held at Peterhead Port Authority on 25 June 2014.

The purpose of the workshop was to identify and review the potential navigational hazards associated with the planned development of the Hywind Scotland Pilot Park Project within the Buchan Deep, offshore from Peterhead in the north east of Scotland, just beyond the 12nm limit. The results of the Hazard Review Workshop form an important part of the Navigation Risk Assessment for the proposed development.

Hazard rankings are also presented.

2. Attendees

The following people attended the workshop:

Organisation	Name
Hywind Scotland Limited	Sigmund Lunde
	Jostein Bolstad-Lind
	Amir Mohd Ghazali
Peterhead Port Authority	John Forman
	Sandy Watt
Maritime and Coastguard Agency (Aberdeen)	Fiona Hastie
ASCO Marine and Marine Safety Forum (MSF)	Euan Simpson
Northern Lighthouse Board (NLB)	Archie Johnstone
Peterhead Marina	James Clubb
Peterhead Royal National Lifeboat Institution (RNLI)	Alistair Wilson
Scottish Fishermen's Federation (SFF) Services	Peter Duncan
	Andrew Buchan
	James Buchan (skipper)
	Philip Buchan (skipper)
Anatec	John Beattie
	Judith Murray

Representatives from the following organisations and shipping companies were invited but unable to attend:

- Chamber of Shipping
- RYA & RYA Scotland
- Cruising Association

- Bibby
- Craig Group
- GulfMark
- Vroon

3. Minutes

The key notes from the shipping and navigation hazard workshop for the Hywind Scotland Pilot Park Project are summarised in the following sub-sections.

3.1 Introduction

- The above attendees introduced themselves and the organisation they were representing.
- An overview of the project was given by HSL. This included details of the Statoil Hywind Demo project and Wind Turbine Generator (WTG) Unit, installed off Haugesund in Norway in 2009 and operational since then with no significant problems.
- An approximate timescale for the installation of the Hywind Scotland Pilot Park Project was given, with installation of mooring lines and anchor chains carried out in April 2016, followed by installation of the WTG Units in May / June 2017.
- Anatec presented baseline vessel activity and incident data for the area to set the context for the Hazard Review discussion. This included review of offshore industry vessel traffic, fishing vessel activity and recreational traffic. (It was noted that AIS does not fully cover small vessel activity and therefore other data sets are being used as well as local consultation.)
- The methodology for the Hazard Review was outlined. The objective was to identify and review the various navigational hazards associated with the Hywind Scotland Pilot Park Project.
- Hazards were identified, possible causes discussed and potential risk control measures examined. Several of the risk control measures discussed under one hazard could be applicable to more than one hazard.

3.2 Hazard Review

The draft list of hazards prepared for the meeting were reviewed and agreed. The following hazards were discussed:

1. Powered vessel collision with WTG;
2. Drifting vessel collision with WTG;
3. Vessel-to-vessel collision due to avoidance of site and/or work vessels;
4. Fishing interaction with midwater mooring lines and power cables and anchors;
5. Fishing interaction with export cable;
6. Vessel anchor interaction with subsea equipment;
7. WTG total loss of station; and
8. Work vessel collision with other vessel (during Installation / Maintenance)

It was emphasised at the outset that the discussion needed to take into account differences between types of vessels, e.g., oil & gas, fishing and recreational. The key points from the discussion of each hazard are summarised below.

3.2.1 Hazard 1 - Powered Vessel Collision with WTG Unit

Discussion

This hazard is that a vessel transiting past the Pilot Park Project collides with a WTG unit while steaming in transit.

MSF mentioned that the cause of a powered collision could be inadequate passage planning such as using the site as a waypoint and failing to alter course when appropriate. RNLI and MCA highlighted that the NE corner of the site is busy.

The distance from Peterhead Port was noted by NLB. The Pilot Park Project is located just outside the 12nm limit, thus outbound vessels leaving port will be beginning to stand down on the bridge, and the crew may be distracted by other tasks, such as paperwork. Inbound to Peterhead, there are likely to be "more eyes" on the bridge as the vessel prepares for arrival. This will vary for other destinations and departure ports such as Aberdeen.

NLB stated that marking and lighting of the Pilot Park Project could be complicated if a "no-go" area was in place. A phased (and synchronised) approach to marking and lighting was suggested, with marking and lighting in place prior to the fully operational phase.

RNLI pointed out that the existing AIS coverage is not ideal in the Buchan Deep area. A new base station may be required at Hywind. NLB noted that one station could cover all 5 WTGs (i.e., broadcast all the positions) using a synthetic signal. Further consultation is planned with NLB, who will need to provide statutory sanction for the marking and lighting, including any use of AIS.

MCA asked about vessels which do not have AIS, i.e., smaller vessels which are not subject to the carriage requirements (currently fishing vessels below 15m length and recreational craft). Fisheries surveillance data and Anatec's consultation with the SFF indicated most fishing vessels working in the Buchan Deep area (over 12 miles) would be 15m and above and therefore required to carry AIS, although the skippers at the meeting indicated there could be smaller vessels at times. There is not a great deal of recreational traffic though could be a few yachts transiting between Scotland and Scandinavia. An indication of numbers will be obtained from Peterhead Marina. Larger yachts may carry AIS, as it helps them see (and be seen) by other vessels but they are not obliged to broadcast at all times.

Discussions have been held with the MCA and DECC regarding the potential for safety zones around turbines (up to 500m) although this is more aimed at protecting against fishing interaction with subsea equipment rather than surface navigation. It is expected that steaming vessels would seek to maintain an adequate clearance during passage, whether there are safety zones in place or not.

MSF noted that the concept of safety zones is not new and that vessels operating off the east coast of the UK, especially oil & gas industry vessels (about two-thirds of the traffic in the area of Hywind) are used to these zones being in place around fixed and mobile oil installations, including many subsea installations.

The MCA can monitor traffic but would not police any safety zones. They can caution vessels if there is evidence they are not doing what they are told, e.g., regularly infringing any safety zone, but this would be after the event, not live surveillance. PPA would also not want to be involved in policing the site as it is beyond their jurisdiction.

Statoil Marine in Bergen provides 24 hour monitoring of oil and gas assets (and safety zones) in the North Sea, using AIS. The HSL Hywind Pilot Park Project will be included within this and there will be live AIS monitoring. There are no plans for radar monitoring during normal operations.

MCA suggested the frequency of this hazard would be low. A vessel would not intentionally want to collide with a WTG Unit, and would collide only if unaware of the presence of the Pilot Park Project. It was felt this would be the case with or without a safety zone.

Overall, it was agreed there is always potential for a collision but the frequency is expected to be quite rare for the Hywind site. In terms of consequences, MSF suggested this would be less than for an oil & gas installation as the WTG does not have risers. HSL commented that as it is a floating unit it will move away from a collision so a ship us unlikely to stem the turbine, a glancing impact is more likely.

A guard vessel was identified as a key mitigation during initial activities, when awareness of the Pilot Park Project will be low. PPA suggested the vessel issue regular SECURITE messages to increase awareness. Information should also be included in Maritime Safety Information (MSI) broadcasts routinely made by the MCA for the area.

How the site and associated cables, mooring lines and anchors are depicted on charts will need to be discussed with the UKHO.

Peterhead Marina commented that charts on recreational vessels can be outdated, with the majority using Imray charts. There is a need to find out how these are updated, presumably via the UK Hydrographic Office (UKHO), and make sure they are informed of the presence of the Pilot Park Project. Similarly for updating the relevant Sailing Directions and Almanacs. Local marinas and harbours can publicise the development on Notice Boards as electronic methods are not always effective. Consultation with equivalent bodies to the RYA in Norway and targeting foreign recreational users would also help promulgate information regarding the Pilot Park Project to leisure users.

<u>Summary of Potential Causes</u>

- Adverse weather;
- Poor visibility;
- Radar interference;
- Manoeuvring error;
- Steering gear failure;
- Navigational aid failure;

- Equipment failure;
- Lack of awareness;
- Lack of experience;
- Lack of passage planning;
- Human error;
- Non-AIS (smaller vessels).
- Fatigue; and
- Watchkeeper failure.

<u>Summary of Potential Risk Controls</u>

- Marking and Lighting;
- AIS Transceiver;
- AIS Monitoring;
- Raising awareness of the Pilot Park Project;
- Maritime Safety Information broadcasts;
- Notices to Fishermen;
- Fisheries Liaison;
- Sharing of information within industry;
- Liaison with recreational sailing community;
- Liaison with MSF;
- Up-to-date charts;
- Kingfisher publications;
- Emergency contact available 24hrs per day;
- Emergency Response Cooperation Plan (ERCoP) to be agreed with MCA prior to installation;
- Guard vessel during major work on site;
- Bridge watchkeeping;
- Passage planning by vessels;
- Safety zones; and
- Minimum air clearance of 22m from sea level (all tidal states).

<u>Risk Review</u>

- This hazard was discussed as being of low frequency, but it was noted that there is always potential for an incident.
- Probable consequences of collision were assessed as being minor damage to vessels, with the impact of a collision with a WTG Unit being less serious than a collision with an offshore (oil & gas) platform as no risers. Any collision is likely to be glancing as it will be almost impossible to stem the WTG which will move away.
- The rotor blades can be shutdown by the onshore control centre in the event of an incident.

<u>Post Workshop Note:</u>

In the risk ranking sheet this hazard has been divided into three parts to cover three different types of vessel:

a. *Merchant ship (e.g., oil & gas);*
b. *Fishing vessel; and*
c. *Recreational vessel.*

3.2.2 Hazard 2 - Drifting Vessel Collision with WTG

Discussion

A vessel which loses power in the vicinity of the Pilot Park Project could drift towards the site under the influence of the prevailing conditions (wind and wave) and collide with a WTG.

It was noted that there is good holding ground for anchoring in the vicinity of the site, with the substrate comprising of soft sand, shells, mud and gravel. Merchant vessels and fishing vessels should be able to anchor in the area, but the water is too deep for recreational craft.

MCA commented that its priority would be to rescue people in danger on a drifting vessel, not to salvage the vessel or prevent a collision. PPA only has a small harbour tug. HSL will have a personnel craft in the local area (Windcat type) which may be able to assist a smaller vessel. However, given the nature of the traffic in the area, i.e., oil & gas vessels going to and from Aberdeen and Peterhead, many of which are tugs, there is a good prospect of a suitable vessel being available to aid a drifting vessel. Although not guaranteed, this makes the Hywind site safer than elsewhere in the UK for this scenario.

Anatec mentioned that information on tug availability and potential emergency response to any incidents in and around the Pilot Park Project will be included in the ERCo Plan, which is an MCA requirement prior to installation.

Summary of Potential Causes

- Vessel emergency;
- Adverse weather;
- Manoeuvring error;
- Equipment failure;
- Lack of awareness;
- Lack of experience; and
- Human error.

Summary of Potential Risk Controls

- Anchoring by drifting vessel (good holding ground);
- Start engines by dragged anchor vessel;
- AIS Monitoring;
- Emergency Response Cooperation Plan (ERCoP);
- Towing vessel availability (above average);
- Marking and lighting; and
- Emergency shutdown system.

Risk Review

- Frequency considered to be lower than powered collision as historically black outs on vessels are infrequent.

- Consequences similar to Hazard 1 but collisions are likely to be at lower speed and hence lower energy.
- Likely to be more warning of a drifting scenario, compared to powered, therefore better prospect of recovery or emergency response.

3.2.3 Hazard 3 - Vessel-to-Vessel Collision due to avoidance of Site or Work Vessels

Discussion

Vessels will have to re-route around the Hywind Pilot Park array of five turbines which will alter the rate of encounters and therefore potential vessel-to-vessel collisions.

NLB highlighted the problem with new navigation technology, such as GPS, which can result in all vessels altering course at the same waypoint which leads to convergence, e.g., vessels may insert a new waypoint in their passage plan 0.5 miles west or north of the Park.

Trials by the MCA and the wind farm industry have proven that the large steel turbine structures can cause false echoes on marine radar when passing within 1.5 nautical miles. This is mainly an issue in bad visibility when visual sightings cannot be used to confirm if the target is genuine. These effects will be of a lesser extent compared to Round 1 & 2 UK wind farms, due to there being only five structures present within a smaller overall footprint.
Overall, the reduction in sea room and re-routeing is likely to result in an increase in the risk of collisions. However, as the turbine locations occupy a relatively small footprint area of approximately 5km^2, the increase is likely to be marginal.

It was also noted the presence of the Pilot Park Project will add an additional hazard for mariners to be aware of, which will potentially make them more vigilant when navigating through the area.

Summary of Potential Causes

- Adverse weather;
- Poor visibility;
- Radar interference;
- Manoeuvring error;
- Steering gear failure;
- Navigational aid failure;
- Equipment failure;
- Lack of awareness;
- Lack of experience;
- Lack of passage planning;
- Human error;
- Fatigue;
- Watchkeeper failure; and
- Failure to comply with Colregs.

Summary of Potential Risk Controls

- Marking and Lighting;
- AIS Transceiver;
- Raising awareness of the Pilot Park Project;
- Maritime Safety Information broadcasts;

- Notices to Fishermen;
- Fisheries Liaison;
- Sharing of information within industry;
- Liaison with recreational sailing community;
- Liaison with MSF;
- Up-to-date charts;
- Kingfisher publications;
- Emergency contact available 24hrs per day;
- Emergency Response Cooperation Plan (ERCoP);
- Watchkeeping;
- Passage planning by vessels; and
- Compliance with Colregs.

Risk Review

- This hazard was considered to be relatively low frequency.
- Consequences will depend on the vessels involved but could range from minor damage to sinking of vessels, with potential fatalities.

3.2.4 Hazard 4 – Fishing Interaction with Midwater Mooring Lines and Power Cables and Anchors

Discussion

Fishing vessel gear will have the potential to interact with midwater mooring lines and power cables and anchors at the HSL Hywind Pilot Park Project.

SFF highlighted the necessity to make fishermen aware of the exact position of mooring lines and anchors via awareness charts (paper and electronic) issued by Kingfisher / FishSafe, as well as more generally via UKHO chart updates. The vast majority of fishing vessels in this area would be equipped with FishSAFE units, which provide an audible and visual alarm if the vessel is operating near charted obstructions / hazards.

HSL would prefer to exclude fishing from the area, including the midwater mooring lines and power cables and anchors, for safety reasons (to protect mariners). Discussions have been held with the MCA and DECC regarding the potential for safety zones or an Area To Be Avoided (ATBA) to achieve this. There is a mechanism to apply to DECC for up to 500m safety zones. The midwater power cables will have seabed touch down at a radius of approximately 250-300m. The anchors would extend a further 200-300m (approximately) beyond the safety zones if these were centred on the turbines. A risk-based case would need to be made to DECC / MCA therefore the question was asked whether stakeholders felt exclusion was necessary on safety grounds.

NLB pointed out that anchor lines from drilling rigs and floating installations (e.g., FPSOs) in the North Sea extend outside safety zones. However, HSL noted that these tend to be embedded anchors under the seabed whereas the suction anchors planned at Hywind will protrude above the seabed and pose an increased risk of interaction with trawled gear. Anchors are 6m in diameter, 18m long and will protrude approximately 2m. HSL indicated that over-trawl protection is not a practical option.

The fishermen accepted the need for safety zones around the turbines but felt they could "protect themselves" and manage the risks associated with fishing in proximity to lines and anchors. They would fish close to the 500m zone then pull off, avoiding crossing the lines and anchors. (Anatec has observed this type of activity at North Sea FPSOs by fishing vessels tracked on AIS.)

Other stakeholders present felt that an exclusion zone would help protect fishermen against risky practices, but the skippers felt that it was highly unlikely that a local vessel would take a risk, both on safety and economic grounds (potential damage to gear), and that raising awareness was the most effective safety measure.

HSL noted that chains will not be removed over the life of the project as they will last for the duration of the project by design. If an anchor were to fail it would require replacing in a different position and fishermen will be informed via industry liaison and updated charts.

Mooring lines and anchors will be in place one year prior to the installation of WTG Units, thus there will be 15 mooring lines laid on the seabed for approximately one year before any surface structures are visible. SFF noted that these would pose a hazard to trawling but not to surface navigation. SFF suggested that guard vessel(s) would be required during and following installation of the mooring lines and anchors, until there is any surface structure present. The period of raising awareness should begin prior to installation of the mooring lines and anchors. NLB suggested that cardinal buoys could be used to physically mark the presence of a hazard on the seabed, with Admiralty Charts noting the position of the buoys.

Summary of Potential Causes

- Adverse weather;
- Manoeuvring error;
- Equipment failure;
- Lack of awareness;
- Lack of experience;
- Human error;
- Fatigue; and
- Fishing vessels attracted to site.

Summary of Potential Risk Controls

- Marking and Lighting;
- AIS Transceiver;
- AIS Monitoring;
- Raising awareness of the Pilot Park project;
- Maritime Safety Information broadcasts;
- Notices to Fishermen;
- Fisheries Liaison;
- FishSAFE units;
- Sharing of information within industry;
- Up-to-date charts;
- Kingfisher publications;
- Issue Notices to Mariners;
- Emergency contact available 24hrs per day;
- Emergency Response Cooperation Plan (ERCoP);
- Abandon gear in event of snag;
- Guard vessel in the period between mooring and turbine installation;
- Temporary buoyage in the period between mooring and turbine installation; and
- Exclusion of fishing in area of mooring lines and anchors.

Risk Review

- Relatively low frequency if fishermen were well aware of the Pilot Park Project and the positions of mooring lines and anchors.
- Safety zones may help remove the temptation of fishing vessels “taking a chance”.

- Consequences are loss of fishing gear, damage to vessel, risk of capsize and associated fatalities. It was noted that the initial impact of gear snagging is when the danger of capsize occurs, and that this would be a worst-case scenario. Gear snagging and loss of gear would be a more likely consequence.

3.2.5 Hazard 5 – Fishing Interaction with Export Cable

Discussion:

Fishing vessel gear will have the potential to interact with the export cable running from the Park to the landfall point along the coast at Peterhead (to be finalised). The export cable will be installed prior to the WTG Units.

Once established, appropriate mitigation is needed to ensure the cable is suitably protected against the type of fishing (i.e., scallop and clam dredging) and anchoring in the area. This may include trenching, burial and the use of rock dumping, depending on the nature of the seabed.

SFF considered it essential to have a guard vessel on site following installation of the export cable until it has been buried / trenched or otherwise protected. This is usually only a short time.

Skippers confirmed they would fishing over and across the cable, on the assumption it is protected.

Anatec noted that a Burial Protection Index (BPI) study is usually carried out as a condition of the consent and submitted to the MCA prior to installation, as full details of the cable route and protection measures are not normally finalised at the time of the NRA.

Summary of Potential Causes

- Inadequately protected cable;
- Adverse weather;
- Manoeuvring error;
- Steering gear failure;
- Equipment failure;
- Lack of awareness;
- Lack of experience;
- Human error;
- Fatigue;
- Watchkeeper failure; and
- Fishing vessels attracted to cable route.

Summary of Potential Risk Controls

- BPI study;
- Cable protection, e.g. burial;
- Abandon gear;
- Marking and Lighting;
- Raising awareness of the Pilot Park project;
- Maritime Safety Information broadcasts;
- Notices to Fishermen;

- Fisheries Liaison;
- FishSAFE;
- Sharing of information within industry;
- Up-to-date charts;
- Kingfisher publications;
- Issue Notices to Mariners;
- Emergency contact available 24hrs per day;
- Emergency Response Cooperation Plan (ERCoP);
- AIS Monitoring;
- Guard vessel in period between laying and protecting the cable; and
- Periodic surveying of cable route to ensure protection is maintained.

Risk Review

- The potential hazard can be effectively mitigated with suitable cable protection. Where the ground conditions allow, burial below 60cm is normally sufficient to protect against fishing gear interaction, but a mobile seabed, e.g., sand waves, may require deeper burial, as well as periodic surveys to ensure the cable stays protected.
- Consequences are loss or damage to fishing gear, risk of capsize and associated fatalities. It was noted that the initial impact of gear snagging is when the danger of capsize occurs, and that this would be a worst-case scenario. Gear snagging and loss of gear would be a more likely consequence.
- Other consequences are damage to the Project itself, including severe damage and possible breakage of the export cable, which may occur when a large fishing vessel's gear snags on the cable. Breaking of the cable would impact on business and may require total replacement of the cable. The replacement and repair operation will be possible only on good-weather days in the summer season, with all power production being halted until replacement or repair has been undertaken. The cable will take 12-18 months to replace at a cost of £10-30 million.

3.2.7 Hazard 6 – Vessel Anchor Interaction with Subsea Equipment, including Export Cable

Discussion

Vessel anchors have the potential to interact with midwater mooring lines and power cables connected to the WTG Unit and anchors at the HSL Hywind Pilot Park Project and with the export cable running from the Pilot Park Project to the landfall point along the coast at Peterhead.

Anchoring is very unlikely in the deeper water of Buchan Deep, although it could take place by a transiting vessel in an emergency. Vessels are more likely to anchor in shallower water near to shore when seeking shelter, as they await a berth or orders. Therefore, the risk is likely to be higher for the export cable than the mooring lines or inter-array cables.

It was noted by PPA that vessels do not routinely anchor east of Peterhead, but there is occasional anchoring off the coast to the north and south. There have been no recent reports of dragged anchor incidents in the area so this is an uncommon event.

As previously mentioned, there is good holding ground for anchors in the area. Competent mariners would be expected to check charts to ensure they are clear of subsea equipment before dropping anchor, even in an emergency. Therefore, ensuring the cable is marked on charts is effective mitigation.

As part of the BPI study (post-consent), additional protection will be assessed for any areas where vessels are identified to anchor. AIS data will be reviewed as part of the BPI assessment.

Summary of Potential Causes

- Dragged anchor;
- Adverse weather;
- Steering gear failure;
- Equipment failure;
- Lack of awareness;
- Lack of experience;
- Human error;
- Fatigue; and
- Watchkeeper failure.

Summary of Potential Risk Controls

- Anchoring by drifting vessel (good holding ground);
- Start engines by dragged anchor vessel;
- Not a traditional anchoring area;
- BPI study;
- Cable protection, e.g., burial;
- Anchor Watch / Guard Zone by vessel at anchor;

- Marking and Lighting;
- Raising awareness of the Pilot Park Project;
- Maritime Safety Information broadcasts;
- Notices to Fishermen;
- Fisheries Liaison;
- Sharing of information within industry;
- Up-to-date charts.
- Kingfisher publications;
- Issue Notices to Mariners;
- Emergency Response Cooperation Plan (ERCoP);
- AIS Monitoring;
- Towing vessel availability (above average);
- Guard vessel in period between mooring and turbine installation;
- Temporary buoyage in the period between mooring and turbine installation; and
- Guard vessel during cable-laying.

Risk Review

- This hazard was discussed as being relatively low frequency as little anchoring occurs in the vicinity of the Pilot Park Project.
- Consequences are more likely to be financial than safety related.

3.2.8 Hazard 7 – WTG Total Loss of Station

Discussion

This hazard is that the mooring system fails causing the WTG Unit to completely lose station and drift, causing a navigational hazard beyond the Park.

The mooring system is being designed to DNV codes. The system is designed to be stable in the event of single line failure leaving two of the three lines in place (in fact there will be less tension as load will be shared by two anchors). This would lead to only a minor amount of additional excursion of the WTG unit from its central location (approx. 100m-200m). If this were to happen, an automatic alarm would sound and an emergency response would be initiated, e.g., vessel sent from Peterhead to investigate. Cables would not be affected as they will be designed with a Lazy S configuration.

Regular checks of the mooring system will be carried out by ROV.

Statoil has 18 anchored oil & gas platforms in the North Sea which equates to over 4,000 anchor-line years with not a single line failure.

It was noted that a WTG Unit which has lost station totally, i.e. all three mooring lines broken, may represent a threat to damage the BP's Forties Pipeline System in the vicinity of the park. The mooring system is, however, intact with two mooring lines working. DNV is currently undertaking a Risk Analysis of this threat. Preliminary results show that dragging anchor chain over the pipeline will not damage the pipeline, only result in "scratches" and non-significant surface damage to the concrete coating of the pipeline. The suction anchors will be designed to stay in place in all load conditions, including all Accidental Load Cases. This is a hazard that HSL are reviewing in detail with BP, with a specialist study being undertaken on the probability of anchor line failure. (This will be referenced in the NRA.)

Worst case, if a turbine were to drift it would be likely to be stranded quickly if moving towards shore, given its deep draft. An emergency response plan will be developed for recovery, for example, using a towing vessel.

Anchors are likely to withstand any interaction with fishing gear.

Summary of Potential Causes

- Structural failure;
- Design flaw;
- Impact; and
- Adverse weather.

Summary of Potential Risk Controls

- Emergency shutdown system;
- Emergency contact available 24hrs per day;
- Emergency Response Cooperation Plan (ERCoP);

- Safety Management System;
- Position Monitoring and Alarm;
- Inspection and maintenance procedures;
- Design and 3rd party verification of mooring system; and
- Speciality study on risk of anchor failure for Forties Pipeline.

Risk Review

- This hazard was assessed as being remote as the likelihood of single or multiple mooring line failure will be very low. This matches Statoil's North Sea experience in oil & gas.
- Consequences to people are low, but high for damage to property and business.

3.2.9 Hazard 8 – Work Vessel Collides with Other Vessel

Discussion

Working vessels for the Project will have the potential to collide with other transiting vessels whilst operating in the site or en route to / from the site during construction, maintenance and decommissioning of the Project.

HSL highlighted that, once installed, the only routine vessel operations at the site will be a personnel craft for maintenance and an ROV support vessel for under water inspections.

Guard vessel(s) may also be used temporarily to mitigate risks and increase awareness during the early stages.

Rolling safety zones of 500m radii during construction are industry-standard to protect installation vessels and their personnel.

Summary of Potential Causes

- Adverse weather;
- Poor visibility;
- Radar interference;
- Manoeuvring error;
- Steering gear failure;
- Navigational aid failure;
- Equipment failure;
- Lack of awareness;
- Lack of experience;
- Lack of passage planning;
- Human error;
- Fatigue;
- Watchkeeper failure; and
- Failure to comply with Colregs.

Summary of Potential Risk Controls

- Marking and Lighting;
- Raising awareness of the Pilot Park Project;
- Maritime Safety Information broadcasts;
- Notices to Fishermen;
- Fisheries Liaison;
- Sharing of information within the industry;
- Liaison with recreational sailing community;
- Liaison with MSF;
- Up-to-date charts;
- Kingfisher publications;
- Emergency contact available 24hrs per day;

- Emergency Response Cooperation Plan (ERCoP);
- AIS Monitoring;
- Guard vessel during major work on site.
- Passage planning;
- Adverse weather working policy and procedures;
- Marine coordination and operating procedures;
- AIS Monitoring;
- Personal Protective Equipment (PPE);
- Safety Management System (SMS);
- Compliance with Colregs; and
- Safety zones.

Risk Review

- This hazard was discussed to be of relatively low frequency.
- Consequences will depend on the vessels involved but could range from minor damage to sinking of vessels, with potential fatalities.

3.3 Other

The towing operation from the assembly area to the Buchan Deep site was identified to have unique risks which are not covered by the workshop or the NRA but will need further consideration once more details are known.

4. Hazard Ranking Methodology

The ranking of the risks associated with the various hazards was subsequently carried out based on the discussion at the Workshop and review of the baseline data and other consultation. This was circulated to attendees after the meeting for feedback. A risk matrix was used based on the frequency and consequence categories shown below.

Table 4.1 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

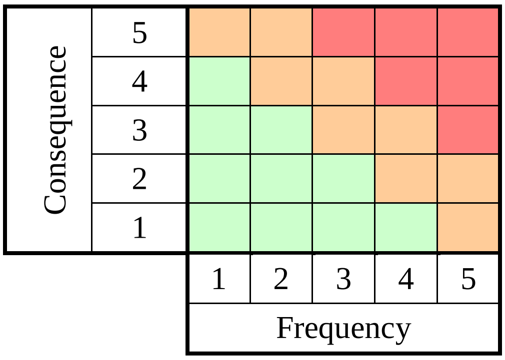
Table 4.2 Consequence Bands

Rank	Description	Definition			
		People	Environment	Property	Business
1	Negligible	No injury	<£10k	<£10k	<10k
2	Minor	Slight injury(s)	Tier 1: Local	£10k-£100k	£10k-£100k

Rank	Description	Definition			
		People	Environment	Property	Business
			assistance required		
3	Moderate	Multiple moderate or single serious injury	Tier 2: Limited external assistance required	£100k-£1M	£100k-£1M Local publicity
4	Serious	serious injury or single fatality	Tier 2: Regional assistance required	£1M-£10M	£1M-£10M National publicity
5	Major	More than 1 fatality	Tier 3: National assistance required	>£10M	>£10M International publicity

The four consequence scores were 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.

Table 4.3 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.

The hazard was ranked by expected risk (based on the estimated frequency versus consequence) with no (or basic) mitigation measures applied, and residual risk following application of industry standard measures and additional mitigation identified during consultation and at the Hazard Review Workshop.

5. Risk Rankings

The final hazard log contained a total of 10 navigational hazards (due to Hazard 1 being considered under three different vessel types) with the following overall breakdown by tolerability region presented in Figure 5.1.

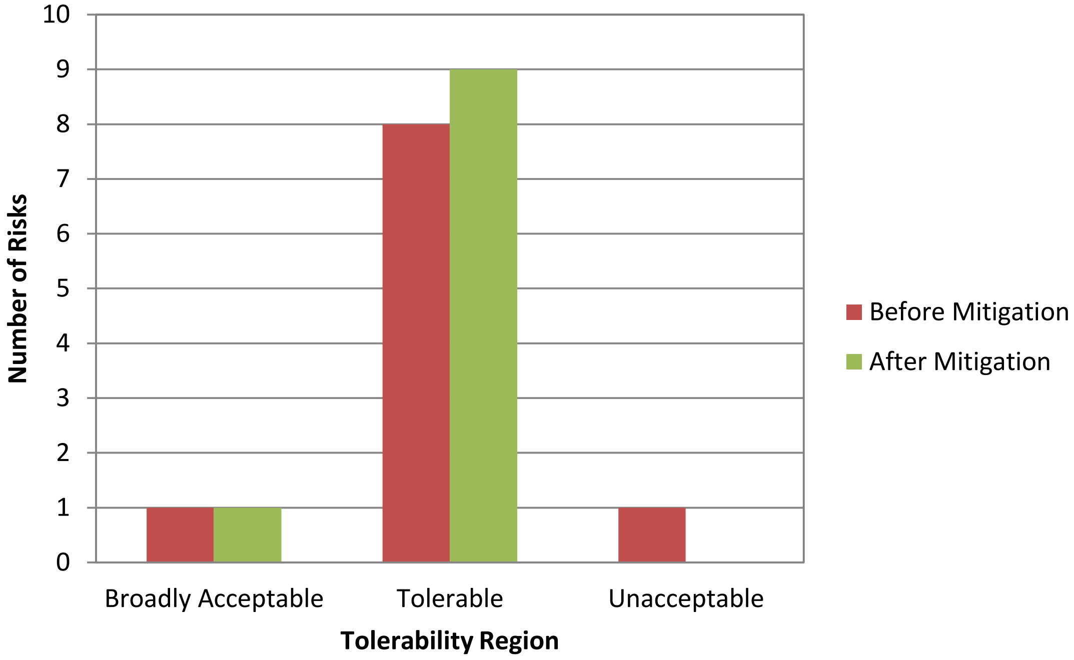


Figure 5.1 Hywind Scotland Pilot Park Project Risk Ranking Results

One hazard, fishing interaction with midwater mooring lines and power cables and anchors, was assessed as being Unacceptable pre-mitigation. Potential mitigation measures identified at the workshop for this hazard are listed below:

- Abandon gear in event of snag;
- Marking and Lighting;
- Raising awareness of the Pilot Park project;
- Maritime Safety Information broadcasts;
- Notices to Fishermen;
- Fisheries Liaison;
- FishSAFE;
- Sharing of information within industry;
- Up-to-date charts;
- Kingfisher publications;
- Issue Notices to Mariners;
- Emergency contact available 24hrs per day;
- Emergency Response Cooperation Plan (ERCoP);
- AIS Monitoring;
- Guard vessel in period between mooring and turbine installation;

- Temporary buoyage in the period between mooring and turbine installation; and
- Exclusion of fishing in area of mooring lines and anchors.

By applying the appropriate mitigation, the risk was assessed to reduce to a Tolerable (ALARP) level.

Eight other hazards were identified as being Tolerable before mitigation. However, there is still a requirement that such risks are properly assessed and appropriate control measures are put in place to ensure the residual risks are ALARP. The potential mitigation measures identified for each hazard are listed in Appendix A.

One hazard, WTG unit loses station, was ranked as Broadly Acceptable based on the significant redundancy in the mooring system already built-in to the design.

Full details of the logged and ranked hazards are summarised below.

ID	Phase	Hazard	Description	Possible Causes	Ranking before Mitigation			Potential Mitigation Measures	Ranking after Mitigation		
					Frequency	Consequences	Risk		Frequency	Consequences	Risk
1a	ALL	Powered merchant vessel collision with WTG Unit, e.g., offshore oil & gas industry vessel	Merchant vessel collides with WTG Unit whilst steaming. Most passages are by oil & gas industry vessels to / from Aberdeen and Peterhead.	Adverse weather; Poor visibility; Radar interference; Manoeuvring error; Steering gear failure; Navigational aid failure; Equipment failure; Lack of awareness; Lack of experience; Lack of passage planning; Human error; Fatigue; Watchkeeper failure.	3	3	9	Marking and Lighting; AIS Transceiver; AIS Monitoring; Raising awareness of the Pilot Park Project; Maritime Safety Information broadcasts; Sharing of information within industry; Liaison with MSF; Up-to-date charts; Emergency contact available 24hrs per day; ERCoP; Guard vessel during construction; Watchkeeping; Passage planning by vessels; Safety zones.	2	3	6
1b	ALL	Fishing vessel collision with WTG Unit	Fishing vessel collides with WTG Unit whilst steaming. Mostly local (Scottish) vessels operating in the area.	Adverse weather; Poor visibility; Radar interference; Manoeuvring error; Steering gear failure; Navigational aid failure; Equipment failure; Lack of awareness; Lack of experience; Lack of passage planning; Human error; Fatigue; Watchkeeper failure; Non-AIS (below 15m length).	3	4	12	Notices to Fishermen; Fisheries Liaison; Kingfisher Publications; Marking and Lighting; AIS Transceiver and reliable coverage; Raising awareness of the Pilot Park Project; Maritime Safety Information broadcasts; Sharing of information within industry; Up-to-date charts and almanacs; Emergency contact available 24hrs per day; ERCoP; Guard vessel during construction; Watchkeeping; Passage planning by vessels; Safety zones.	2	4	8
1c	ALL	Recreational vessel collision with WTG Unit	Yacht collides with WTG Unit whilst steaming or under sail. Relatively infrequent transits of the area by vessels crossing between Scotland and Scandinavia. Likely to be lower speed impact but craft less robust.	Adverse weather; Poor visibility; Radar interference; Manoeuvring error; Steering gear failure; Navigational aid failure; Equipment failure; Lack of awareness; Lack of experience; Lack of passage planning; Human error; Fatigue; Watchkeeper failure; Non-AIS (majority).	2	4	8	Liaison with Recreational Sailing Community; Marking and Lighting; AIS Transceiver and reliable coverage; Raising awareness of the Pilot Park Project; Maritime Safety Information broadcasts; Sharing of information within industry; Up-to-date charts and almanacs; Emergency contact available 24hrs per day; ERCoP; Guard vessel during construction; Watchkeeping; Passage planning by vessels; Safety zones; Minimum air clearance of 22m from sea level (all tidal states).	2	4	8
2	ALL	Drifting vessel collision with WTG Unit	Vessel loses power or drags anchor and drifts with wind and/or tide towards WTG Unit.	Vessel emergency; Adverse weather; Manoeuvring error; Equipment failure; Lack of awareness; Lack of experience; Human error.	2	4	8	Anchoring by drifting vessel (good holding ground); Start engines by dragged anchor vessel; ERCoP; AIS Monitoring; Towing vessel availability (above average); Marking and Lighting; Emergency shutdown system.	2	3	6
3	ALL	Vessel-to-vessel collision due to avoidance of site or support vessels	Displaced traffic increases congestion outside of the site. This can lead to a change (increase) in vessel-to-vessel encounters and ultimately collisions. Could be exacerbated by potential radar interference caused by turbines. For this project, the small footprint of the array and the distance from shore (beyond 12nm) means the impact should be limited.	Adverse weather; Poor visibility; Radar interference; Manoeuvring error; Steering gear failure; Navigational aid failure; Equipment failure; Lack of awareness; Lack of experience; Lack of passage planning; Human error; Fatigue; Watchkeeper failure; Failure to comply with Colregs.	3	4	12	Marking and Lighting; AIS Transceiver; Raising awareness of the Pilot Park Project; Communications with fishermen; Maritime Safety Information broadcasts; Notices to Fishermen; Fisheries Liaison; Sharing of information within industry; Liaison with Recreational Sailing Community; Liaison with MSF; Up-to-date charts; Kingfisher publications; Emergency contact available 24hrs per day; ERCoP; Watchkeeping; Passage planning by vessels; Compliance with Colregs.	2	4	8

ID	Phase	Hazard	Description	Possible Causes	Ranking before Mitigation			Potential Mitigation Measures	Ranking after Mitigation		
					Frequency	Consequences	Risk		Frequency	Consequences	Risk
4	ALL	Fishing interaction with mid water mooring, power cables lines and anchors	Fishing gear interacts with WTG Unit mooring lines, power cables or anchors. Anchors will protrude appox 2m above the seabed and be approx. 700m from the turbine locations.	Adverse weather; Manoeuvring error; Equipment failure; Lack of awareness; Lack of experience; Human error; Fatigue; Fishing vessels attracted to site; Non-AIS (smaller vessels).	4	4	16	Abandon gear in event of snag; Marking and Lighting; AIS Transceiver; AIS Monitoring; Raising awareness of the Pilot Park Project; Communications with fishermen; Maritime Safety Information broadcasts; Notices to Fishermen; Fisheries Liaison; FishSAFE; Sharing of information within industry; Up-to-date charts; Kingfisher publications; Issue Notices to Mariners / NAVTEX; Emergency contact available 24hrs per day; ERCoP; Guard vessel in period between mooring and turbine installation; Temporary buoyage in the period between mooring and turbine installation; Exclusion of fishing in area of mooring lines, power cables and anchors.	3	4	12
5	ALL	Fishing interaction with export cable	Fishing vessel gear interacts with WTG Unit export cable. Route to be finalised but expected to terminate near Peterhead.	Inadequately protected cable; Adverse weather; Manoeuvring error; Steering gear failure; Equipment failure; Lack of awareness; Lack of experience; Human error; Fatigue; Watchkeeper failure; Fishing vessels attracted to cable route.	3	4	12	Burial Protection Index (BPI) study; Cable protection, e.g. burial; Abandon gear; Raising awareness of the Pilot Park Project; Communications with fishermen; Maritime Safety Information broadcasts; Notices to Fishermen; Fisheries Liaison; FishSAFE; Sharing of information within industry; Up-to-date charts; Kingfisher publications; Notices to Mariners; Emergency contact available 24hrs per day; ERCoP; AIS Monitoring; Guard vessel during cable laying; Periodic surveying of cable route.	2	4	8
6	ALL	Vessel Anchor interaction with Subsea Equipment	Vessel anchor interacts with mooring lines / export cable. Cable route is not near a traditional anchorage area but there is occasional anchoring off Peterhead. Also there is a risk of a transiting vessel anchoring in an emergency.	Dragged anchor; Adverse weather; Steering gear failure; Equipment failure; Lack of awareness; Lack of experience; Human error; Fatigue; Watchkeeper failure.	3	3	9	Anchoring by drifting vessel (good holding ground); Start engines by dragged anchor vessel; Burial Protection Index (BPI) study; Cable protection, e.g. burial; Anchor Watch / Guard Zone by vessel at anchor; Marking and Lighting; Raising awareness of the Pilot Park Project; Communications with fishermen; Maritime Safety Information broadcasts; Notices to Fishermen; Fisheries Liaison; Sharing of information within industry; Up-to-date charts; Kingfisher publications; Notices to Mariners ERCoP; AIS Monitoring; Towing vessel availability (above average); Guard vessel in the period between mooring and turbine installation; Temporary buoyage in the period between mooring and turbine installation; Guard vessel during construction.	2	3	6

ID	Phase	Hazard	Description	Possible Causes	Ranking before Mitigation			Potential Mitigation Measures	Ranking after Mitigation		
					Frequency	Consequences	Risk		Frequency	Consequences	Risk
7	ALL	WTG Unit loses station	WTG Unit loses station and drifts. Significant redundancy in the mooring system so should be low frequency (specialist study being undertaken). Consequences depend on drift direction but most likely is that the turbine will ground. Most effective mitigation is to alert mariners in the area.	Structural failure; Design flaw; Impact; Adverse weather.	2	2	4	Emergency shutdown system; Emergency contact available 24hrs per day; ERCoP; Safety Management System; Position Monitoring and Alarm; Inspection and maintenance procedures; Appropriate design of anchoring and mooring lines; Speciality study on risk of anchor failure for Forties Pipeline.	1	2	2
8	INSTALLATION & MAINTENANCE	Work vessel collides with other vessel	Working vessel associated with the Project collides with other (3rd party) transiting vessel whilst operating in the site or en route to / from the site during installation, maintenance and decommissioning.	Adverse weather; Poor visibility; Radar interference; Manoeuvring error; Steering gear failure; Navigational aid failure; Equipment failure; Lack of awareness; Lack of experience; Lack of passage planning; Human error; Fatigue; Watchkeeper failure; Failure to comply with Colregs.	3	4	12	Marking and Lighting; Raising awareness of the Pilot Park Project; Communications with fishermen; Maritime Safety Information broadcasts; Notices to Fishermen; Fisheries Liaison; Sharing of information within industry; Liaison with recreational sailing community; Liaison with MSF; Up-to-date charts; Kingfisher publications; Emergency contact available 24hrs per day; ERCoP; AIS Monitoring; Guard vessel during construction; Watchkeeping; Passage planning; Adverse weather working policy and procedures; Marine coordination and operating procedures; Personal Protective Equipment (PPE); Compliance with Colregs; Safety zones.	2	4	8

Consequences Assessment
Hywind Scotland
Pilot Park Project
(Appendix B)

Prepared by:	Anatec Limited
Presented to:	Xodus Group Limited on behalf of Hywind Scotland Limited
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TABLE OF CONTENTS

1. 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 Hywind Scotland Pilot Park Project.

The significance of the impact of the wind farm is also assessed based on risk evaluation criteria and comparison with historical accident data in the UK waters[1].

2. 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.

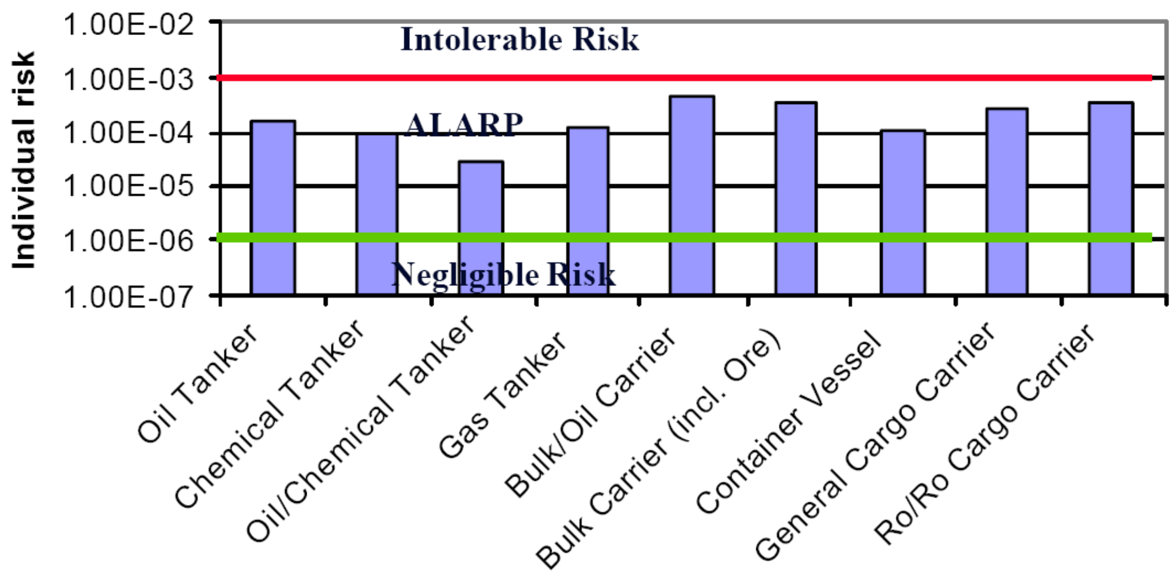

Figure 2.1 Individual Risk Levels and Acceptance Criteria per Ship Type

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.

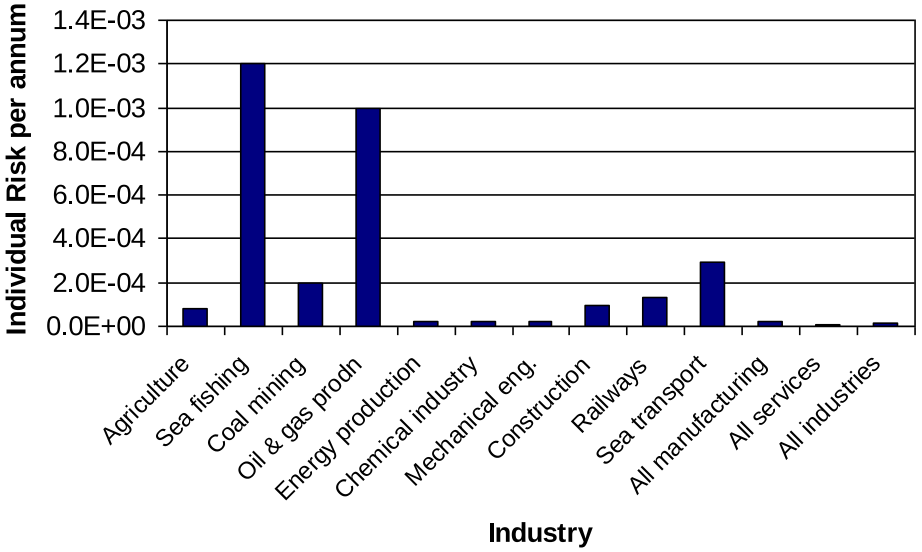

Figure 2.2 Individual Risk per Year for various UK Industries

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 development, 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 the wind farm is the potential amount of oil spilled from the vessel involved in an incident. (Note: Statoil have commissioned a separate, specialist study to assess any potential risk to the BP Forties pipeline in the event of a mooring system failure, therefore this pollution hazard is not covered in this report.)

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 Hywind Scotland Pilot Park Project compared to background pollution risk levels for the UK.

3. 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.

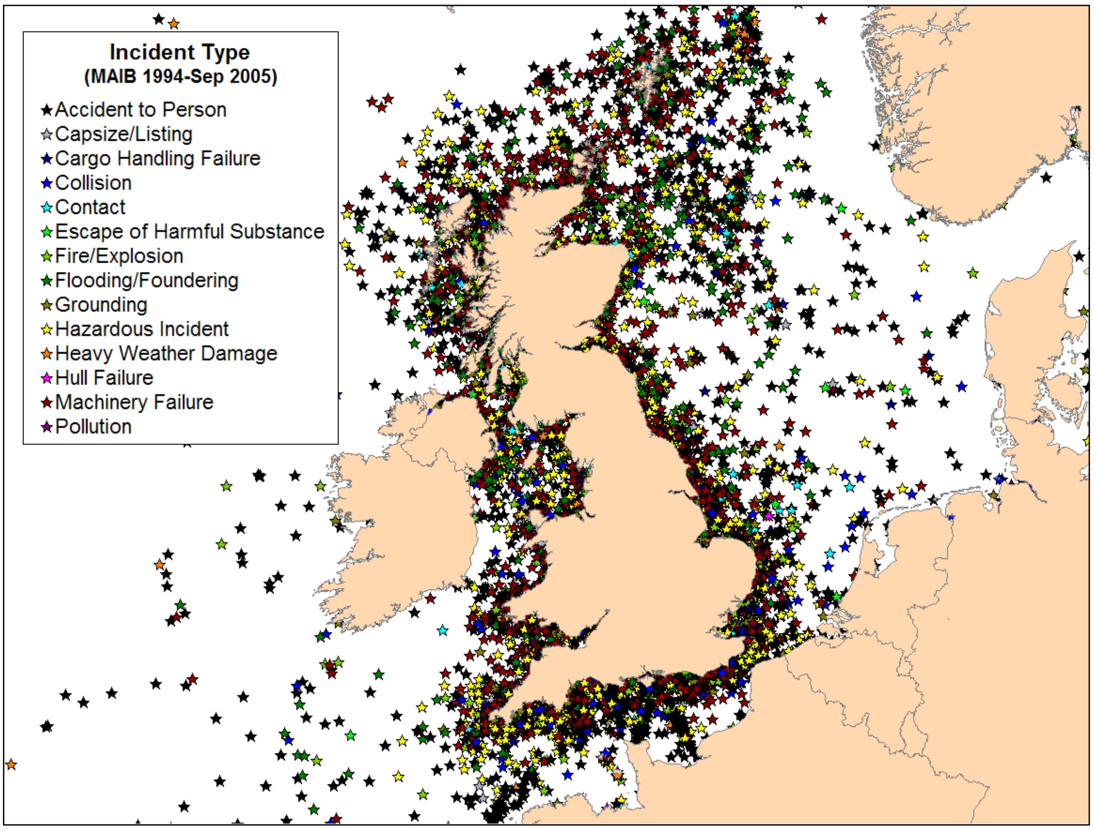

Figure 3.1 Incident Locations by Type (MAIB 1994-Sep 2005)

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

The distribution of incidents by year is presented in Figure 3.2.

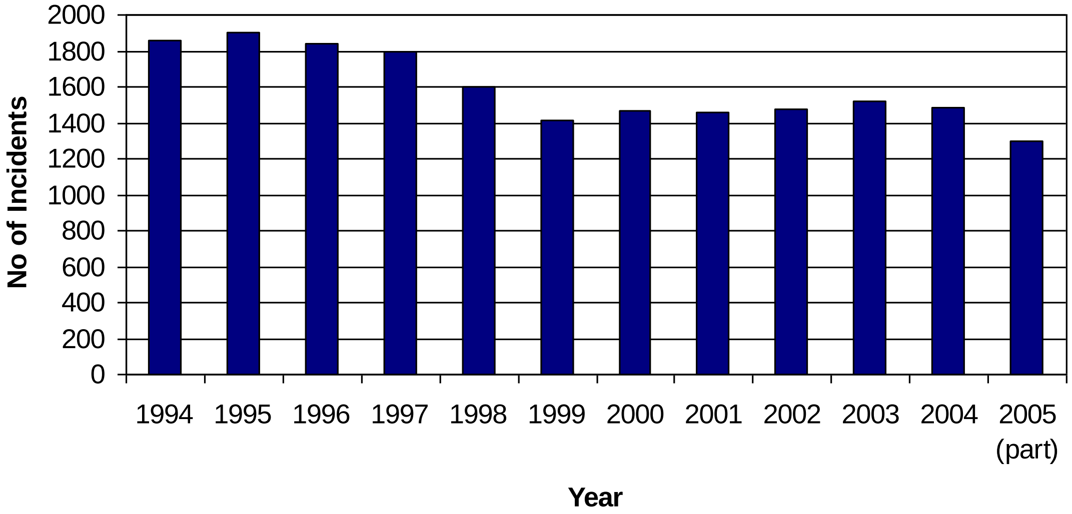

Figure 3.2 Incidents per Year (MAIB 1994-Sep 2005)

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.

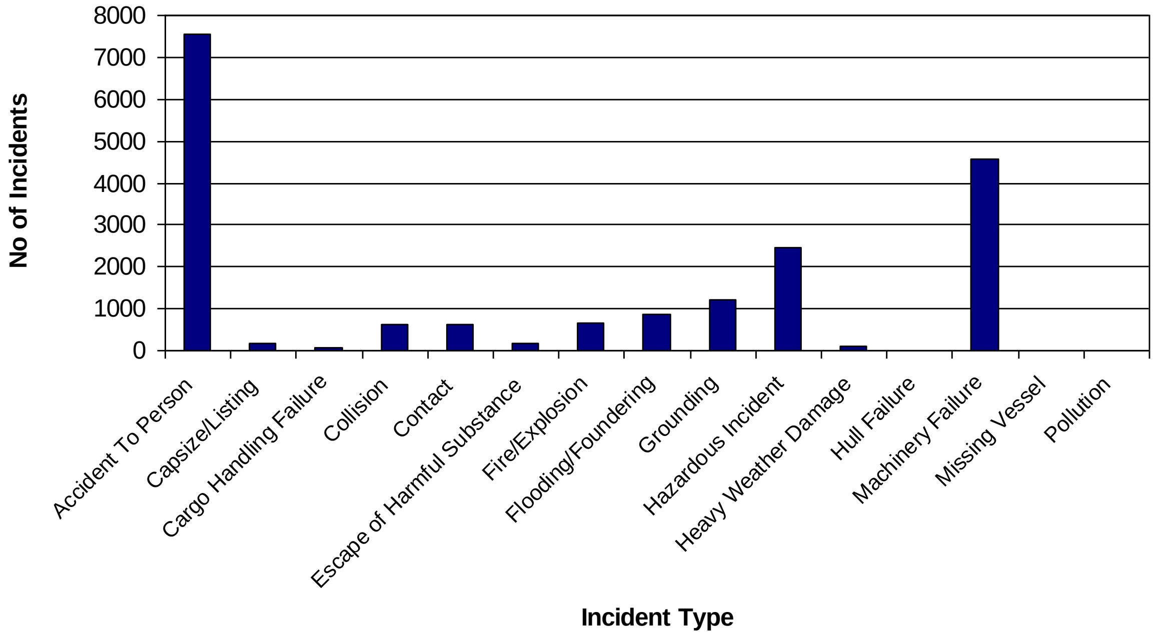

Figure 3.3 Incidents by Incident Type (MAIB 1994-Sep 2005)

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.

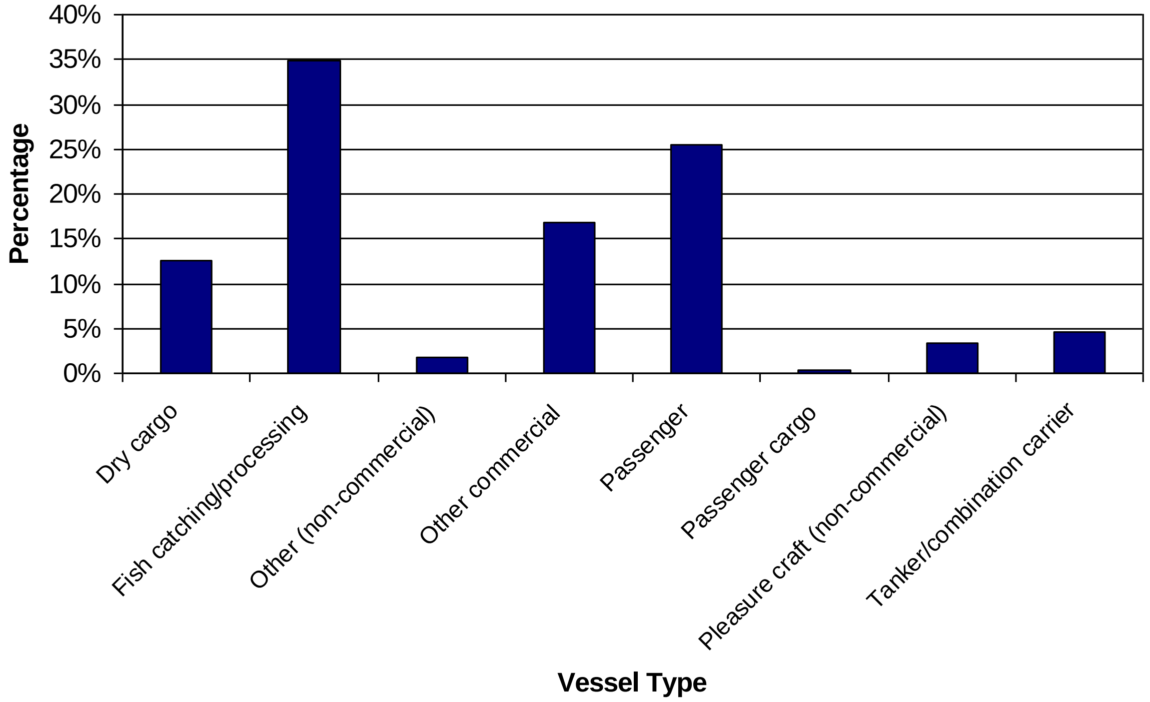

Figure 3.4 Incidents by Vessel Type (MAIB 1994-Sep 2005)

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.

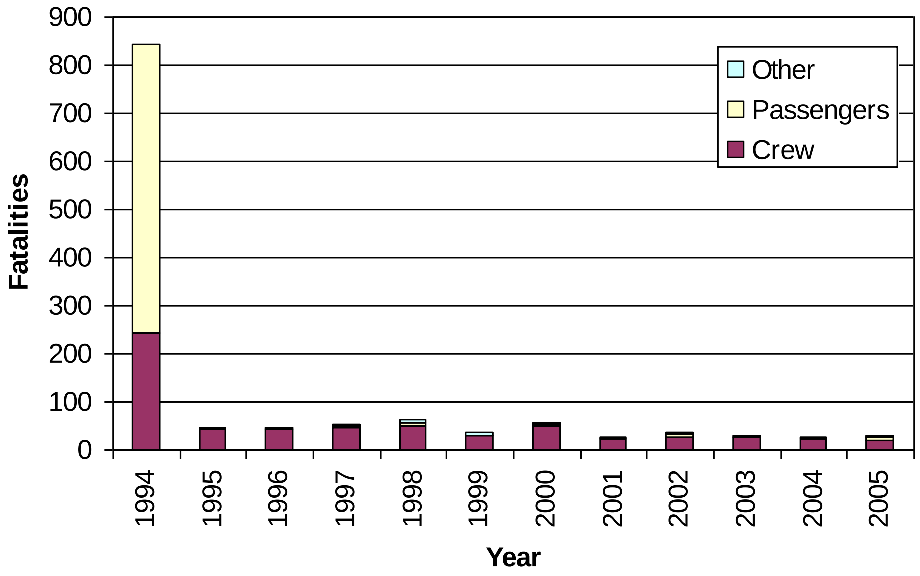

Figure 3.5 Number of Fatalities (MAIB 1994-Sep 2005)

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.

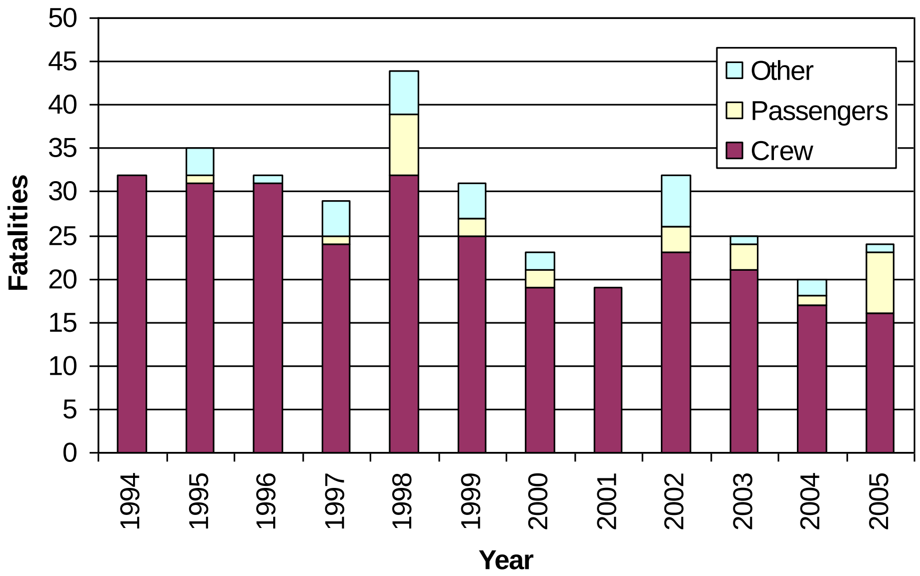

Figure 3.6 Number of Fatalities for Incidents in UK Waters (MAIB 1994-Sep 2005)

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.

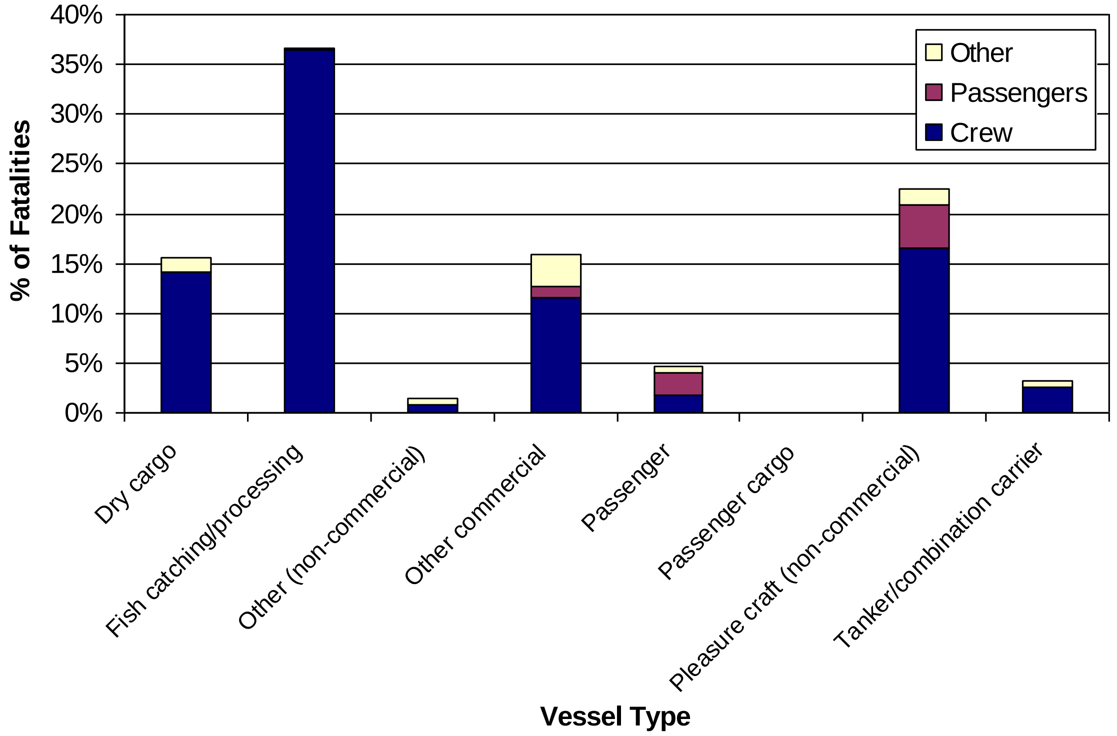

Figure 3.7 Fatalities by Vessel Type for Incidents in UK (MAIB 1994-Sep 2005)

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.

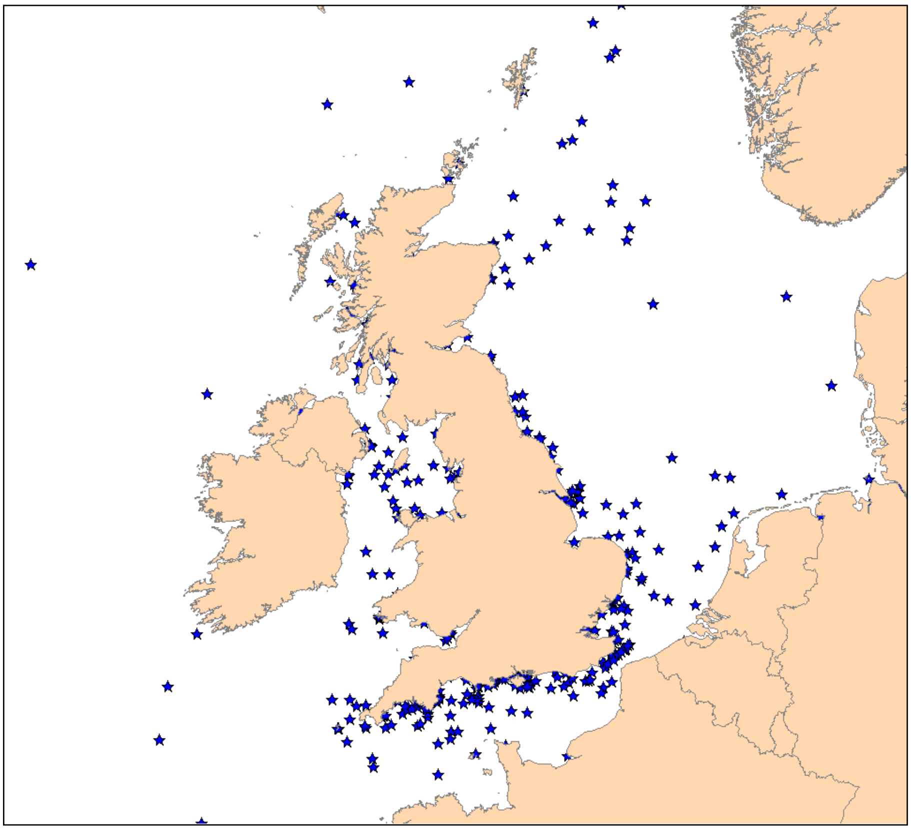

Figure 3.8 Collision Incident Locations (MAIB 1994-Sep 2005)

The distribution of all collision incidents by year is presented in Figure 3.9.

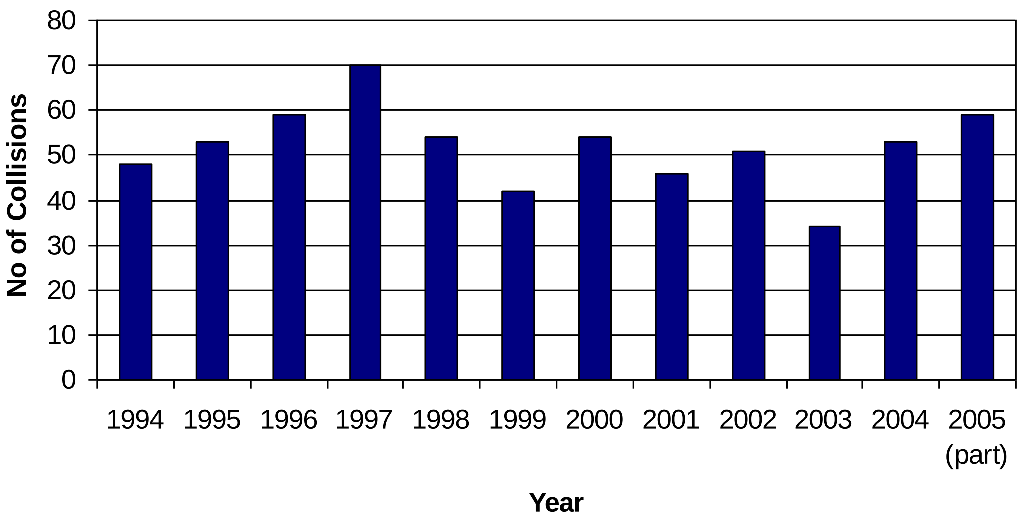

Figure 3.9 Collisions per Year (MAIB 1994-Sep 2005)

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.

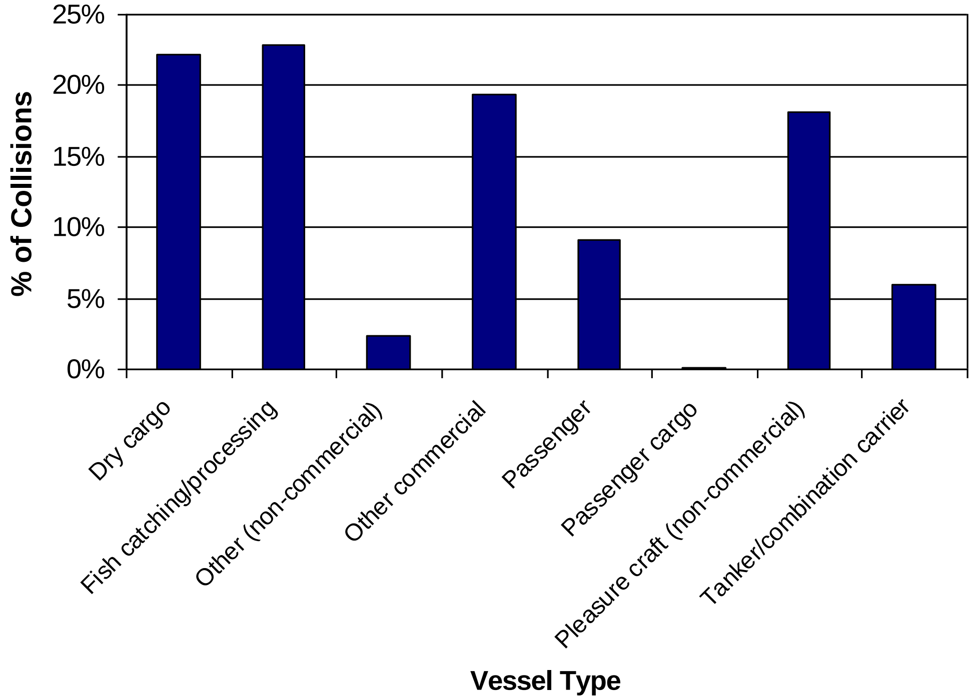

Figure 3.10 Collisions by vessel Type (MAIB 1994-Sep 2005)

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.

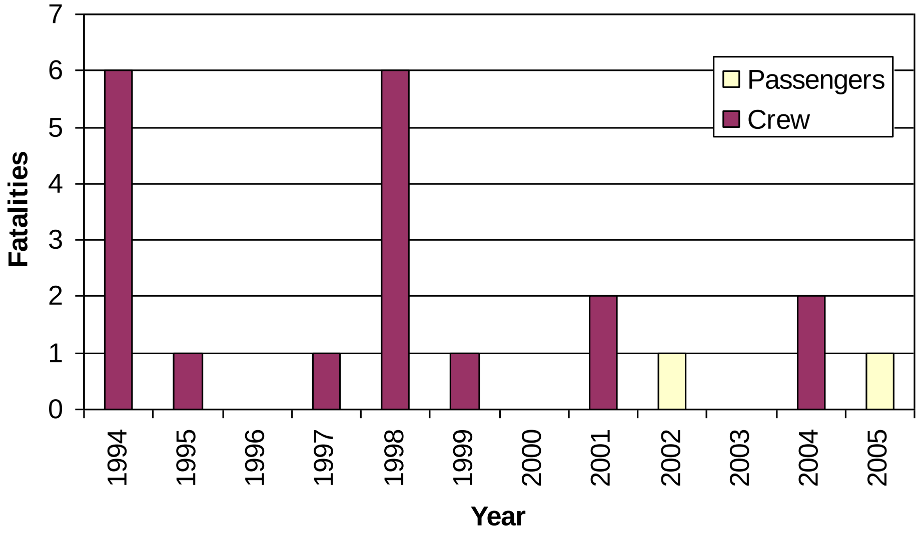

Figure 3.11 Fatalities from Collisions (MAIB 1994-Sep 2005)

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 UK territorial waters, coastal waters, good visibility	1

Date	Description	Fatalities
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.

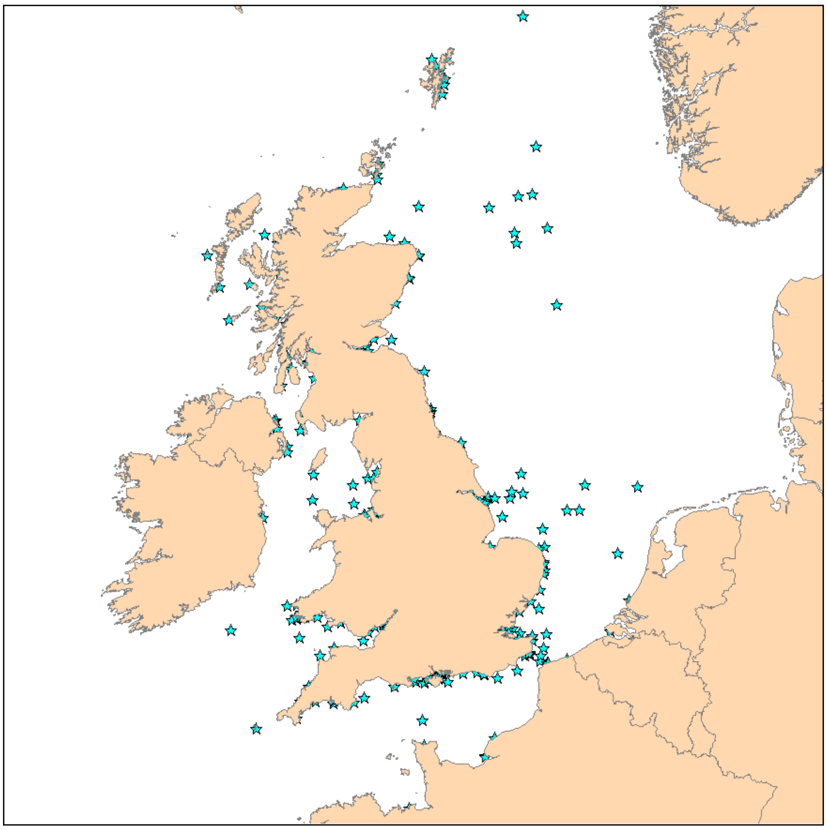

Figure 3.12 Contact Incident Locations (MAIB 1994-Sep 2005)

The distribution of contact incidents by year is presented in Figure 3.13.

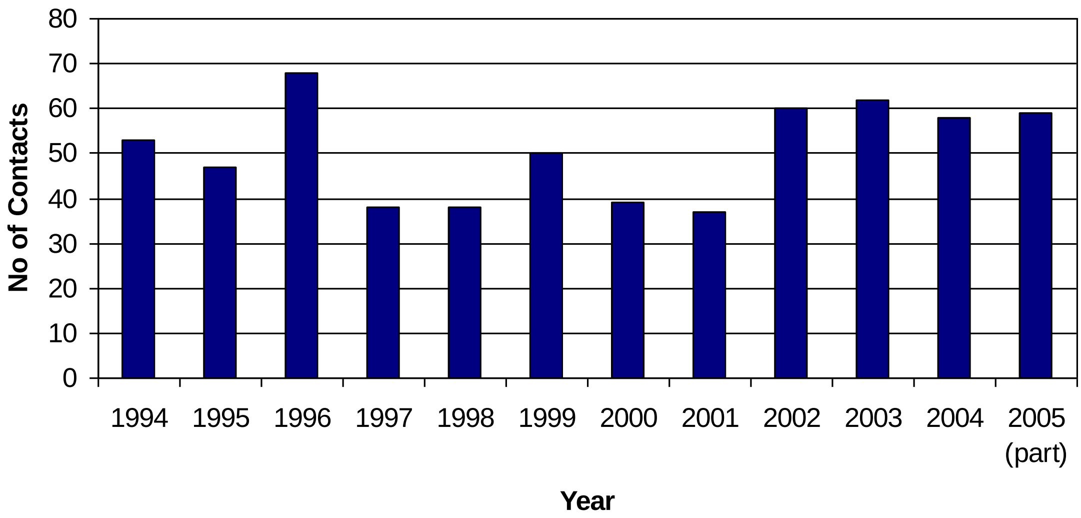

Figure 3.13 Contact Incidents per Year (MAIB 1994-Sep 2005)

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.

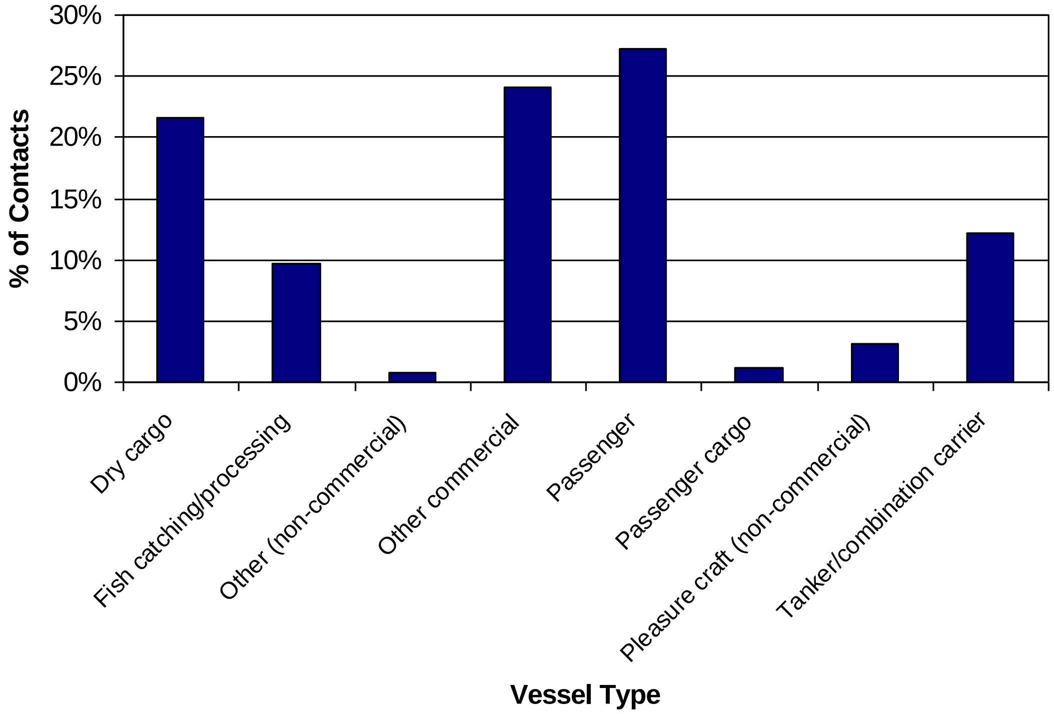

Figure 3.14 Contacts by Vessel Type (MAIB 1994-Sep 2005)

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.

4. 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 wind farm.

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 Wind Farm

The base case and future case annual collision frequency levels without and with the wind farm are summarised below.

Table 4.2 Summary of Annual Collision Frequency Results

Collision Scenario	Base Case			Future Case		
	Without	**With**	**Change**	**Without**	**With**	**Change**
Passing Powered	--	1.17E-04	1.17E-04	--	1.28E-04	1.28E-04
Passing Drifting	--	9.37E-06	9.37E-06	--	1.03E-05	1.03E-05
Vessel-to-Vessel	1.95E-02	1.97E-02	1.55E-04	2.15E-02	2.17E-02	1.70E-04
Fishing	--	2.94E-04	2.94E-04	--	3.24E-04	3.24E-04
Total	1.95E-02	2.01E-02	5.75E-04	2.15E-02	2.21E-02	6.33E-04

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.	400
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 the wind farm is presented in Figure 4.1.

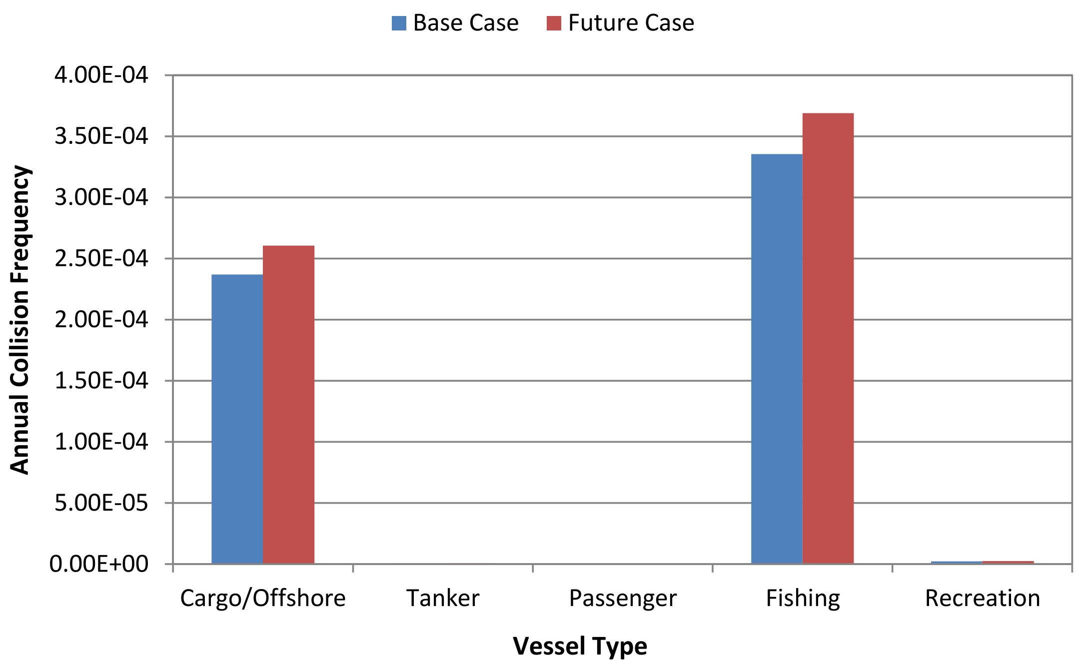

Figure 4.1 Change in Collision by Vessel Type Estimated for Wind Farm

It can be seen that the change in collision frequency is dominated by fishing vessels, followed by cargo/offshore 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 the development is estimated to be as follows:

- Base Case PLL: 1.4×10^{-5} fatalities per year
- Future Case PLL: 1.5×10^{-5} fatalities per year

The estimated base case PLL increase equates to an average of one additional fatality in 74,000 years, whilst the future case PLL increase corresponds to an average of one additional fatality in 67,000 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.

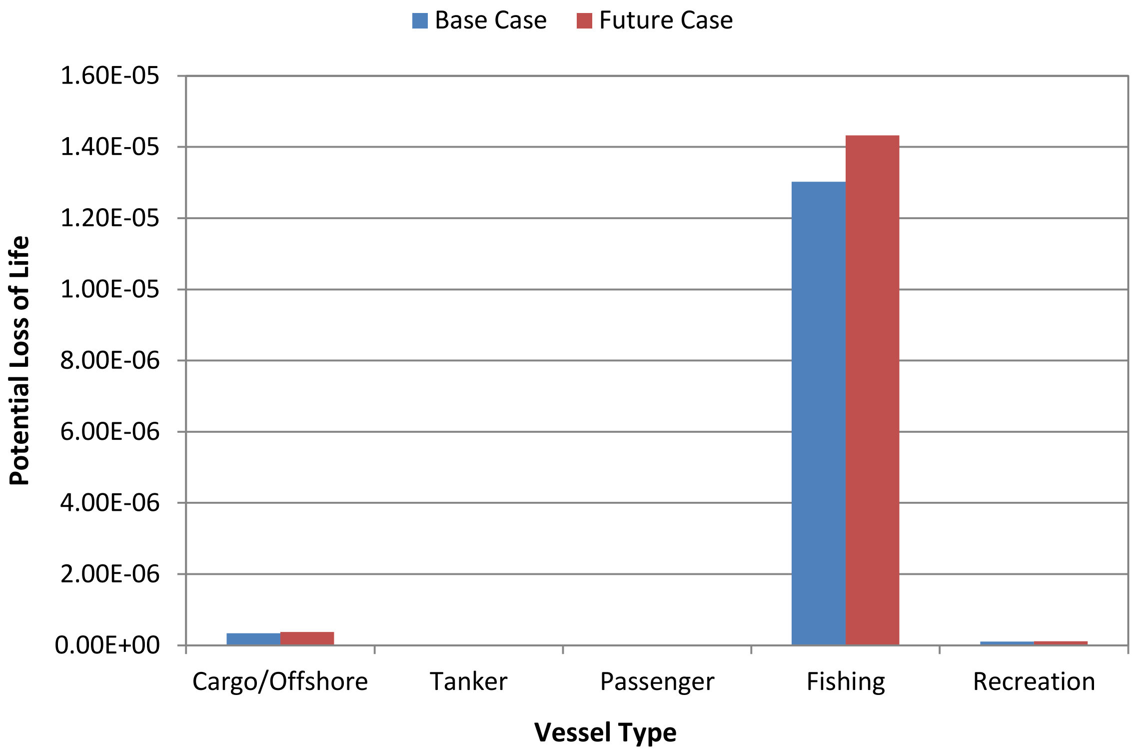

Figure 4.2 Estimated Change in Annual PLL by Vessel Type due to Wind Farm

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).

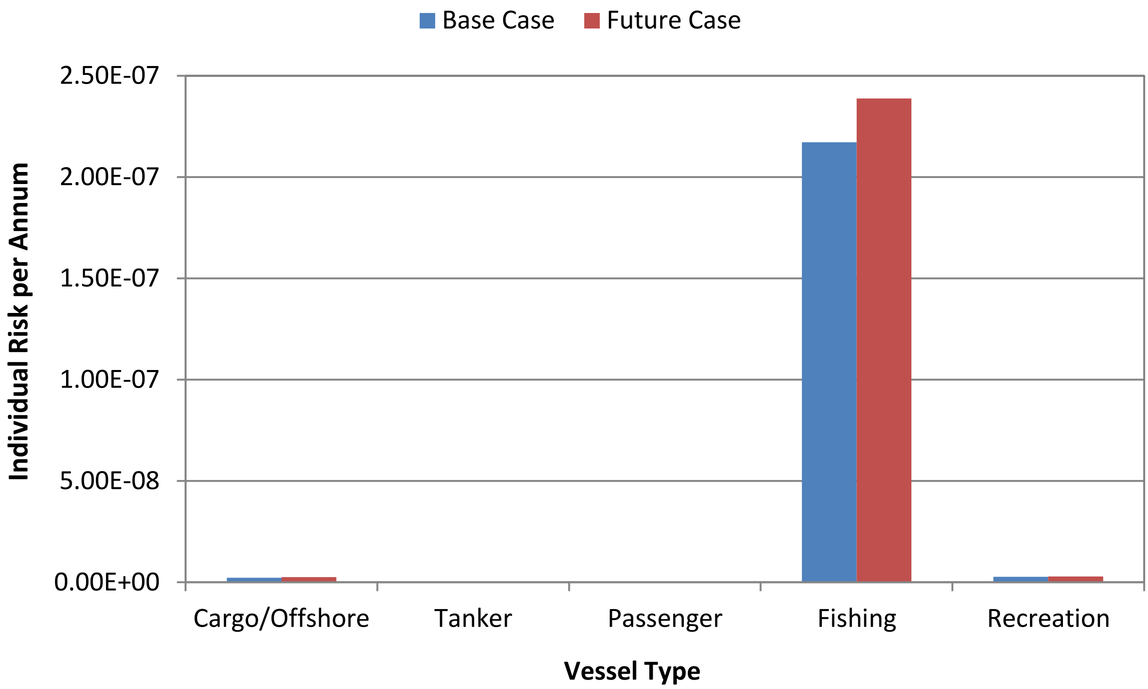

Figure 4.3 Estimated Change in Individual Risk by Vessel Type due to Wind Farm

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

The overall increase in PLL estimated due to the development is 1.4×10^{-5} fatalities per year (base case), which equates to one additional fatality in 74,000 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^{-7}), it is relatively low compared to the background risk level for the UK sea fishing industry of 1.2×10^{-3} per year.

5. 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.

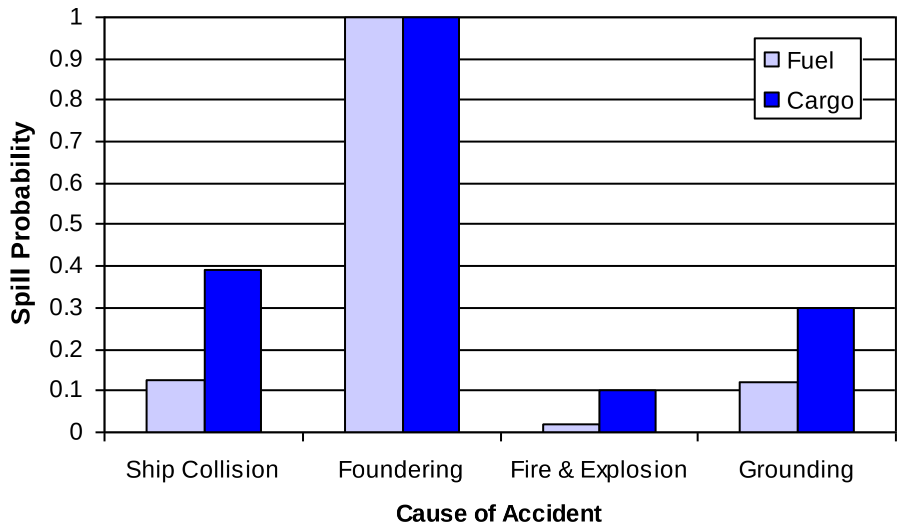

Figure 5.1 Probability of an Oil Spill Resulting from an Accident

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.

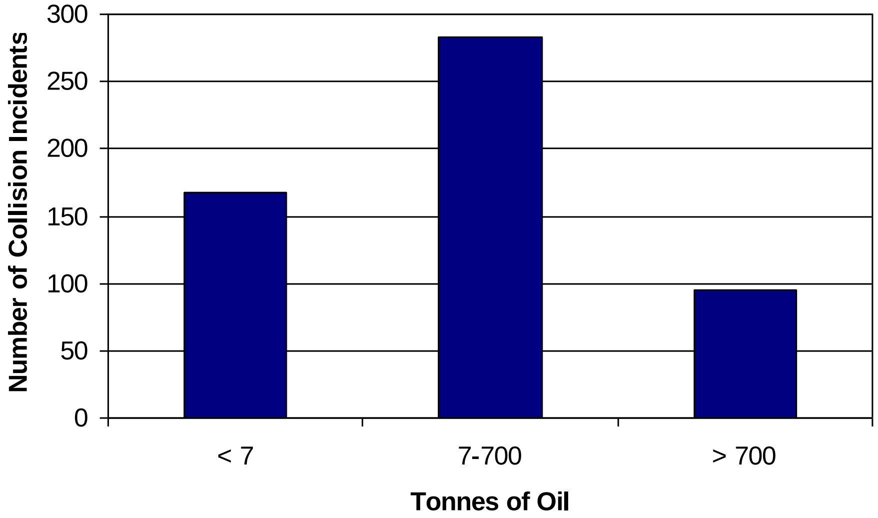

Figure 5.2 Spill Size Distribution in Tanker Collision Incidents (ITOPF 1974-2004)

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 – Hywind Scotland Pilot Park Project

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 the development is estimated to be as follows:

- Base Case: 0.0040 tonnes of oil per year
- Future Case: 0.0044 tonnes of oil per year

The predicted increases in tonnes of oil spilled, distributed by vessel type, is presented in Figure 5.3.

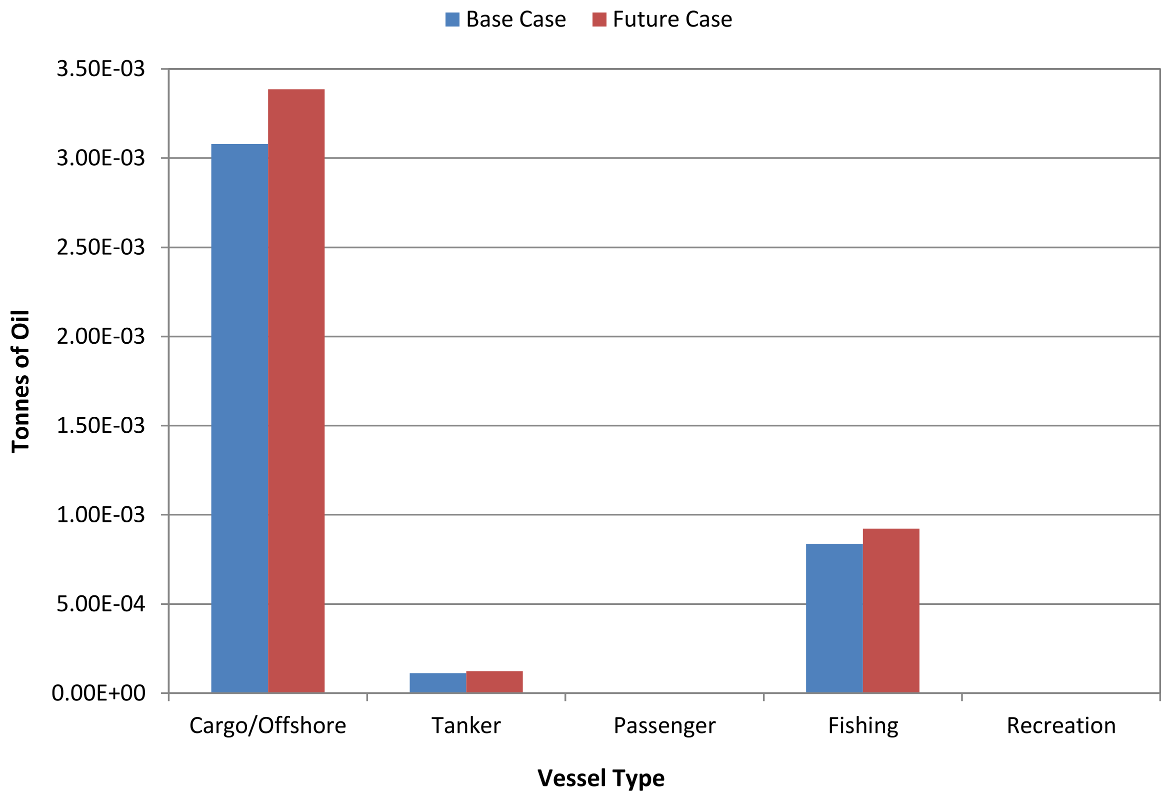

Figure 5.3 Estimated Change in Pollution by Vessel Type due to the Wind Farm

It can be seen that cargo/offshore vessels are the highest contributor.

5.3 Significance of Increase in Pollution Risk

To assess the significance of the increased pollution risk from marine vessels caused by the development, 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 1989-1998 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 the development is very low compared to the historical average pollution quantities from marine accidents in UK waters (approximately 0.00003%).

6. Conclusions

The quantitative risk assessment indicates that the impact of the Hywind Scotland Pilot Park Project on people and the environment is relatively low compared to background risk levels in UK waters.

Overall, the impact of the wind farm on people and the environment is relatively low compared to background risk levels in UK waters. However, it should be noted that this is the localised impact of a single project and there will be additional maritime risks associated with other offshore wind farm projects in the North Sea and the UK as a whole.

Further discussion of mitigation measures and monitoring is provided in the main report.

7. 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 (MEHRAs) in the UK, 2001.

MCA MGN 371 Checklist

Hywind Scotland Pilot Park Project

(Appendix C)

Prepared by:	Anatec Limited
Presented to:	Xodus Group Limited on behalf of Hywind Scotland Limited
Date:	25 November 2014
Revision No.:	02
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1. Introduction

This Annex presents the Maritime and 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 made within Table 1 in Section 2 are based on which sections of the Navigational Risk Assessment or other documents, address the issue noted in the MGN 371 checklist.

2. MGN 371 Compliance Checklist

Table C2.1 MGN 371 Compliance Checklist for the Hywind Scotland Pilot Park Project

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
Annex 1 : Considerations on Site Position, Structures and Safety Zones			
1. Site and Installation Co-ordinates: Developers are responsible for ensuring that formally agreed variations in the co-ordinates of site perimeters and individual OREI structures are made available, on request, to interested parties at all project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided in latitude/ longitude formats.			
2. Traffic Survey			
All vessel types	✓		***Section 4: Data Sources.*** *Tracking of all vessel types was achieved by analysis of AIS data and visual surveys.*
Four weeks duration, within 24 months prior to submission of the Environmental Statement	✓		***Section 4: Data Sources.*** *Survey period comprised 4 x 28 Days, shore-based AIS. 28 Days Summer 2013; 28 Days Autumn 2013; 28 Days Winter 2014; and 28 Days Spring 2014.* ***Section 11: Maritime Traffic Surveys.*** *These four periods encompass seasonal fluctuations in shipping activity and account for a range of tidal conditions. This long-term AIS data exceeds the minimum of four weeks specified in MCA MGN 371. Agreed with MCA and NLB on 26/11/2013 that extended AIS survey was appropriate as opposed to dedicated vessel survey.*
Seasonal variations	✓		***Section 4: Data Sources.*** *Surveys have been carried out in spring, summer, autumn and winter to take account seasonal variations in traffic patterns.*
Recreational and fishing vessel organisations	✓		***Section 4: Data Sources.*** *The periods chosen were designed to cover seasonal variations including small vessel activity variations.*
Port and navigation authorities	✓		***Section 4: Data Sources.*** *Surveys have been carried out in spring,*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			summer, autumn and winter to take account seasonal variations in traffic patterns.
Assessment			
a. Proposed OREI site relative to areas used by any type of marine craft.	✓		***Section 11: Maritime Traffic Surveys.*** *Summarises the results of the AIS Maritime Traffic Surveys and visual observations during project surveys* ***Section 12: Fishing Vessel Activity.*** *Reviews fishing vessel activity in the area based on the Maritime Traffic Surveys, surveillance (sightings and satellite) data and research work reported in the Commercial Fisheries EIA work.* ***Section 13: Recreational Vessel Activity.*** *Examines recreational vessel activity in the area based on the Maritime Traffic Survey, available desktop information and consultation with the RYA / CA.*
b. Numbers, types and sizes of vessels presently using such areas	✓		***Sections 11, 12 and 13 as listed in point a above.***
c. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, etc.	✓		***Section 15: Consultation.*** *Non-transit uses of the area discussed during stakeholder consultation.* ***Sections 11, 12 and 13 as listed in point a above.***
d. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage.	✓		***Section 7: Existing Environment.*** *Based on review of Admiralty Charts.* ***Section 11: Maritime Traffic Surveys.*** *Determines whether these areas contain transit routes used by coastal or deep-draught vessels on passage, by examination of draught details in Maritime Traffic Survey data.*
e. Alignment and proximity of the site relative to adjacent shipping lanes.	✓		***Section 11: Maritime Traffic Surveys.*** *Identifies and assesses the alignment and proximity of the sites relative to adjacent shipping lanes, by analysis of Marine Traffic Survey data.*
f. Whether the nearby area contains prescribed routeing schemes or precautionary areas.	✓		***Section 7: Existing Environment.*** *Based on review of Admiralty Charts and IMO Ship Routeing report.* ***Section 11: Maritime Traffic Surveys.*** *Determines whether vessels follow prescribed routeing schemes and avoid*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			precautionary areas by examination of vessel tracks.
g. Whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes.	✓		***Section 7: Existing Environment.*** *Reviews prescribed zones based on Admiralty Charts and IMO Ship Routeing report.* ***Section 11: Maritime Traffic Surveys.*** *Reviews actual traffic behaviour based on real-time data.*
h. Proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas.	✓		***Section 7: Existing Environment.*** *Examines the proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas, from analysis of Admiralty Charts and Sailing Directions (NP 54).* ***Section 11: Maritime Traffic Surveys.*** *Reviews actual traffic behaviour based on real-time data.*
i. Whether the site lies within port limits, etc. jurisdiction of a port and/or navigation authority.	✓		***Section 7: Existing Environment.*** *Examines whether the site lies within the limits of jurisdiction of a port and/or navigation authority using information from Admiralty Charts and Sailing Directions (Nautical Publication 54).*
j. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.	✓		***Section 12: Fishing Vessel Activity.*** *Reviews the fishing vessel activity at the Project based on the maritime traffic survey, Government surveillance (sightings and satellite) data and the research work reported in the Commercial Fisheries EIA work.*
k. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.	✓		***Section 7: Existing Environment.*** *Analysis of Admiralty Charts, Admiralty Sailing Directions NP 54 and PEXA Charts to determine proximity to military areas.*
l. Proximity of the site to existing or proposed offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks, or other exploration/exploitation sites	✓		***Section 7: Existing Environment.*** *Uses Admiralty Charts and published oil & gas infrastructure data to assess proximity to oil / gas platforms.* *Analyses GIS files based on published data from The Crown Estate to determine proximity to marine aggregate dredging sites.* *Analysed Hydrographic Charts for positions*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			of wrecks in the area.
m. Proximity of the site relative to any designated areas for the disposal of dredging spoil	✓		***Section 7: Existing Environment.*** *Examined positions of dredging spoil grounds taken from Hydrographic Charts.*
n. Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon.	✓		***Section 7: Existing Environment.*** *Used Admiralty Sailing Directions NP 54 to determine proximity to VTS.* *Examined Admiralty Charts and Sailing Directions for positions of navigational aids.*
o. 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.	✓		***Section 17: Risk Modelling and Assessment.*** *Used computer simulation techniques to assess present-day vessel activity and future-case with wind farm activity, with vessels being displaced following construction.* *Examined encounters, vessel-to-vessel collisions (with and without Project), powered and drifting ship collision with structure, fishing vessel collision and recreational vessel collision.*
p. Type(s) of simulation used in analysis Limitation of system(s)	✓		***Section 17: Risk Modelling and Assessment.*** *All the quantified risk assessments were carried out using Anatec's COLLRISK software which conforms to the DECC methodology. 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.*
3. OREI Structures			
a. 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.	✓		***Section 6: Project Description Details.*** *Outlines the Rochdale (Design) Envelope, including WTG Units, anchors, mooring lines, inter-array cables and export cable. There are to be no auxiliary platforms outside the main generator site.* ***Section 9: Emergency Response Overview and Assessment.*** *Summarises the emergency response features of the area.* ***Section 10: Maritime Incidents.***

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			Reviews the maritime incidents that have occurred in the vicinity of the OREI over the last 10 years. ***Section 11: Maritime Traffic Surveys.*** *Considers whether any features of the OREI could pose a danger to vessels underway, performing normal operations or anchoring.* ***Section 12: Fishing Vessel Activity.*** *Assesses the impact of the OREI on vessels engaged in fishing or transiting to fishing grounds.* ***Section 13: Recreational Vessel Activity.*** *Assesses the impact of the OREI on vessels engaged in recreational activities.* ***Section 14: Cable Route Review.*** *Reviews cabling to the shore.* ***Section 15: Consultation.*** *Summarises consultation regarding whether any features of the OREI could pose a danger to vessels underway, performing normal operations or anchoring.* ***Section 16: Formal Safety Assessment and Appendix A.*** *Summarises Hazard Review Workshop regarding whether any features of the OREI could pose a danger to vessels underway, performing normal operations or anchoring.* ***Section 17: Risk Modelling and Assessment.*** *Assesses the impact that the OREI will have upon vessel-to-vessel collisions, vessel to structure allision (powered, drifting and anchor dragging), fishing vessel allisions and recreational vessel collisions.* *Present a summary of results from modelling used to assess whether any features of the OREI could pose any type of difficulty or danger to vessels underway, performing normal operations, or anchoring.*
Clearances of wind turbine blades above the sea surface *not less than 22 metres*	✓		***Section 6.3: Project Description Details – Offshore Components*** *Recommended minimum safe (air) clearances between sea level conditions at MHWS and wind turbine rotors will be not less than 22m and will meet RYA and MCA*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			guidance.
Least depth of current turbine blades	✓		*Not applicable.*
The burial depth of cabling	✓		***Section 6.3: Project Description Details – Offshore Components*** *A Burial Protection Index study will be carried out of the final cable route to ensure appropriate cable protection taking into account fishing and anchoring practices in the area.*
b. 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 9: Emergency Response Overview and Assessment.*** *Summarises the existing emergency response resources in the region and details how they meet the MCA's requirements.* *Summarises SAR helicopter assets in the vicinity of the Project.* *Summarises RNLI lifeboat stations in the vicinity and response times of their vessels to the Project* *Reviews how modernisation of HM Coastguard will impact upon emergency response in the vicinity of the Project* *Examines options for salvage in the vicinity of the Project. Determines whether the installation could create problems for salvage vessels.*
c. With respect to specific OREI devices, how rotor blade rotation, other exposed moving mechanical parts and/or power transmission, etc., will be controlled by the designated services when this is required in an emergency.	✓		***Section 23: Risk Mitigation Measures & Monitoring.*** *States that the Project will meet the MCA's requirements in terms of standards and procedures for generator shutdown and other operational requirements in the event of this being required in an emergency.* *Developers will require to consult and liaise with the local RNLI stations and the Coastguard about the devices to be deployed and provide any further information requested to assist SAR efforts.*
4. 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:			
a. Navigation within or close to the site would be safe:			

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
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	✓ ✓ ✓ ✓ ✓		***Section 11: Maritime Traffic Surveys.*** *Reviews traffic survey to determine whether navigation within the site would be safe.* ***Section 12: Fishing Vessel Activity.*** *Reviews fishing vessel activity in the area based on the survey data and surveillance (sightings and satellite) data.* ***Section 13: Recreational Vessel Activity Analysis.*** *Examines recreational vessel activity within the area based on the available desktop information and on consultation.* ***Section 10: Review of Historical Maritime Incidents.*** *Reviews the maritime incidents that have occurred in the vicinity of the OREI over the last 10 years.* ***Section 15: Stakeholder Consultation.*** *Feasibility of navigation discussed during consultation with a number of relevant stakeholders.* ***Section 17: Risk Modelling and Assessment.*** *Quantitatively assessed hazards of transiting vessel collision, drifting vessel collision and change in vessel-to-vessel collision. Also fishing vessel and recreational vessel collision.*
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.	✓ ✓ ✓ ✓ ✓ ✓		*Relevant sections are cross-referenced under point a (above).* *See also* ***Section 21: Safety Zones.*** *Further discussions with the MCA, DECC and Marine Scotland are planned to agree the final strategy.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
c. Exclusion from the site could cause navigational, safety or routeing problems for vessels operating in the area. e.g by causing a vessel or vessels to follow a less than optimum route	✓		*Relevant sections are cross-referenced under point a (above).*
Relevant information concerning a decision to seek a "safety zone" for a particular site during any point in its construction, operation or decommissioning should be specified in the Environmental Statement accompanying the development application	✓		***Section 21: Safety Zones.*** *Further discussions with the MCA, DECC and Marine Scotland are planned to agree the final strategy.*
Annex 2 : Navigation, collision avoidance and communications			
1. The Effect of Tides and Tidal Streams : *It should be determined whether:*			
i. Current maritime traffic flows and operations in the general area are affected 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.	✓		***Section 6: Project Description Details.*** *States the depth of water in which the proposed installations are to be situated.* ***Section 8: Metocean Data.*** *Examines various states of the tide in the area.* ***Section 10: Review of Historical Maritime Incidents.*** *Reviews maritime incidents that have occurred in the vicinity of the Project over the last 10 years including those related to the water depth.* ***Section 11: Maritime Traffic Surveys*** *Assesses current maritime traffic flows and operations in the general area.* ***Section 17: Risk Modelling and Assessment.*** *COLLRISK models take into account tides in the vicinity of the Project.*
ii. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site.	✓		***Section 8: Metocean Data.*** *Examines various states of the tide in the area.* ***Section 17: Risk Modelling and Assessment.*** *COLLRISK models take into account tides in the vicinity of the Project.*
iii. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout,	✓		***Section 8: Metocean Data.*** *Examines various states of the tide in the area.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
and, if so, its effect.			
iv. The set is across the major axis of the layout at any time, and, if so, at what rate.	✓		***Section 8: Metocean Data.*** *Examines various states of the tide in the area.*
v. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream.	✓		***Section 8: Metocean Data.*** *Examines various states of the tide in the area.* ***Section 17: Risk Modelling and Assessment.*** *COLLRISK models take into account tides in the vicinity of the Project.*
vi. The structures themselves could cause changes in the set and rate of the tidal stream.	✓		*Refer to coastal processes EIA work.*
vii. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the wind farm area or adjacent to the area	✓		*Refer to coastal processes EIA work.*
2. Weather: *It should be determined whether:*			
i. 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.	✓		***Section 8: Metocean Data.*** *Presents metocean statistics for the area.* ***Section 10: Maritime Incidents.*** *Reviews maritime incidents that have occurred in the vicinity of the Project over the last 10 years including those related to bad weather or restricted visibility.* ***Section 11: Maritime Traffic Surveys.*** *Assesses routeing of vessels which pass in close proximity to the site based on conditions experienced during 4 x 28 days spring, summer, autumn, winter.* ***Section 17: Risk Modelling and Assessment.*** *Risk models take into account all-year weather conditions in the vicinity, including probability of fog which historically has been shown to increase collision risk.*
ii. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer.	✓		***Section 22.4: Additional Navigation Issues – Impacts of Structures on Wind Masking/Turbulence or Shear.*** *Assesses whether wind masking, turbulence or sheer could create problems in the area for vessels under sail.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
iii. 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 such as referred to in 2.1 - v. above	✓		***Section 16: Formal Safety Assessment and Appendix A.*** *Drifting vessels discussed during the Hazard Review Workshop.* ***Section 17: Risk Modelling and Assessment.*** *Drifting Ship Collision model assesses whether vessels could drift into danger. The model has been run for different combinations of wind and tide and the worst-case result reported in the assessment.*
3. Visual Navigation and Collision Avoidance: *It should be determined whether:*			
i. The structures could block or hinder the view of other vessels under way on any route.	✓		***Section 16: Formal Safety Assessment and Appendix A.*** *Visual navigation discussed during the Hazard Review Workshop.* ***Section 22.2: Additional Navigation Issues – Visual Navigation and Collision Avoidance.*** *Assesses whether the structures could block or hinder other vessels' view.*
ii. The 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 16: Formal Safety Assessment and Appendix A.*** *Visual navigation discussed during the Hazard Review Workshop.* ***Section 22.2: Additional Navigation Issues – Visual Navigation and Collision Avoidance.*** *Assesses whether the structures could block or hinder the view of navigational aids or landmarks.*
4. Communications, Radar and Positioning Systems : *To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether:*			
i. The 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 16: Formal Safety Assessment and Appendix A.*** *Communications, radar and positioning systems discussed at Hazard Review Workshop.* ***Section 19: Impact on Marine Radar Systems.*** *Assesses whether the structures could produce radar interference.* ***Section 22.8: Additional Navigation Issues – Impacts on Communications and Position Fixing.***

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			Assesses impact of structures upon VHF communications, Navtex, VHF direction finding, AIS and GPS.
ii. The 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 7: Existing Environment.*** *Determines presence of aids to navigation and landmarks in the vicinity.* ***Section 16: Formal Safety Assessment and Appendix A.*** *Radar reflections discussed at Hazard Review Workshop.* ***Section 19: Impact on Marine Radar Systems.*** *Determines whether the structures could produce radar reflections, blind spots, shadow areas or other adverse effects.*
iii. The OREI, in general, would comply with current recommendations concerning electromagnetic interference.	✓		***Section 22.7: Additional Navigation Issues – Electromagnetic Interference on Navigational Equipment.*** *Noted that the OREI would comply with current recommendations concerning electromagnetic interference.*
iv. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.	✓		***Section 22.6: Additional Navigation Issues – Structures and Generators Affecting Sonar Systems in Area.*** *Indicates that no evidence has been found regarding sonar interference.*
v. The site might produce acoustic noise which could mask prescribed sound signals.	✓		***Section 22.9: Additional Navigation Issues – Noise Impact.*** *Determines acoustic noise masking sound signals from the Project.*
vi. Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.	✓		***Section 22.7: Additional Navigation Issues – Electromagnetic Interference on Navigation Equipment.*** *Determines electromagnetic interference on navigation equipment from the Project.*
5. Marine Navigational Marking : *It should be determined:*			
i. 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 6: Project Description Details.*** *Indicative details on how Project will be marked and lighted to meet NLB and IALA guidance.* ***Section 15: Consultation.*** *Consultation sought advice on lighting and marking of the Project. The final*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
			navigational markings will be agreed with the NLB. ***Section 16: Formal Safety Assessment and Appendix A.*** *Lighting and marking discussed at Hazard Review Workshop.*
ii. 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.	✓		*Relevant sections are cross-referenced under point i. (above).*
iii. If the specific OREI structure would be inherently radar conspicuous from all seaward directions - and for SAR and maritime surveillance aviation purposes or would require passive enhancers.	✓		*Relevant sections are cross-referenced under point i. (above).*
iv. If the site would be marked by one or more radar beacons (Racons)	✓		*Relevant sections are cross-referenced under point i. (above).*
v. If the site would be marked by an Automatic Identification System (AIS) transceiver, and if so, the data it would transmit.	✓		*Relevant sections are cross-referenced under point i. (above).*
vi. If the site would be fitted with a sound signal, and where the signal or signals would be sited	✓		*Relevant sections are cross-referenced under point i. (above).*
vii. 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 and lights resolved	✓		*Relevant sections are cross-referenced under point i. (above).*
viii. Whether the proposed site and/or its individual generators would comply in general with markings for such structures, as required by the relevant International Association of Marine Aids to Navigation and Lighthouses or recommended by the Maritime and Coastguard Agency, respectively.	✓		*Relevant sections are cross-referenced under point i. (above).*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
ix. 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. Separate detailed guidance is available from the GLAs on this matter.	✓		*Relevant sections are cross-referenced under point i. (above).*
x. 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.	✓		*Relevant sections are cross-referenced under point i. (above).*
6. Hydrography: In order to establish a baseline, detailed and accurate hydrographic surveys are required to IHO Order 1a standard multibeam bathymetry with final data being supplied as a digital full density data set, and erroneous soundings flagged as deleted but include in the data set. A full report detailing survey methodology and equipment should accompany the surveys.			
Annex 3: MCA template for assessing distances between wind farm boundaries and shipping routes			
Annex 4: 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 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:	✓		***Section 16: Formal Safety Assessment and Appendix A.*** *Reviewed mitigation and safety measures appropriate to the OREI development at Hazard Review Workshop.*
i. Promulgation of information	✓		***Section 16: Formal Safety Assessment and***

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
and warnings through notices to mariners and other appropriate media.			***Appendix A.*** *Promulgation of information and warnings through notices to mariners and other appropriate media discussed as mitigation during Hazard Review Workshop.*
ii. Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC).	✓		***Section 16: Formal Safety Assessment and Appendix A.*** *Discussed at Hazard Review Workshop.*
iii. Safety zones of appropriate configuration, extent and application to specified vessels	✓		***Section 16: Formal Safety Assessment and Appendix A.*** *Discussed at Hazard Review Workshop.* ***Section 21: Safety Zones.*** *Further discussions with the MCA, DECC and Marine Scotland are planned to agree the final strategy on safety zones.*
iv. Designation of the site as an area to be avoided (ATBA).	✓		*Not applicable.*
v. Implementation of routeing measures within or near to the development.	✓		*Not applicable.*
vi. Monitoring by radar, AIS and/or closed circuit television (CCTV).	✓		***Section 16: Formal Safety Assessment and Appendix A.*** *Discussed at Hazard Review Workshop.*
vii. Appropriate means to notify and provide evidence of the infringement of safety zones or ATBAs.	✓		***Section 21: Safety Zones.*** *Further discussions with the MCA, DECC and Marine Scotland are planned to agree the final strategy on safety zones.*
viii. Any other measures and procedures considered appropriate in consultation with other stakeholders.	✓		*Relevant sections are cross-referenced above at beginning of Annex 4.*
ix. Creation of an Emergency Response Cooperation Plan with the relevant Maritime Rescue Coordination Centre - from construction phase onwards.	✓		***Section 16: Formal Safety Assessment and Appendix A.*** *ERCoP discussed at Hazard Review Workshop and impact assessment. Draft will be submitted with application.*
Annex 5: 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.			
1. Design Requirements: The OREI should be designed and constructed to satisfy the following design requirements for emergency rotor shut-down in the event of a search and			

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
rescue - SAR., counter pollution or salvage operation in or around a wind farm or other OREI site:			
i. All wind turbine generators (WTGs) and other OREI individual structures will each 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.	✓		*The final navigational markings will be agreed with the NLB.*
ii. The identification characters 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 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 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.)	✓		*The final navigational markings will be agreed with the NLB.*
iii. 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	✓		*The final navigational markings will be agreed with the NLB.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
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.			
iv. Wind Turbine Generators (WTGs) 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.	✓		*The final navigational markings will be agreed with the NLB.*
v. All OREI generators and transmission systems should be equipped with control mechanisms that can be operated from the OREI Central Control Room or through a single contact point.	✓		*Design will meet MCA requirements.*
vi. Throughout the design process for an OREI, appropriate assessments and methods for safe shutdown should be established and agreed, through consultation with MCA Navigation safety Branch, Search and Rescue Branch and other emergency support services.	✓		*Design will meet MCA requirements.*
vii. The OREI control mechanisms should allow the Control Room Operator to fix and maintain the position of the WTG blades, nacelles and other appropriate OREI moving parts to configurations determined by the Maritime Rescue Co-ordination Centre (MRCC). This same operator must be able to immediately effect the control of offshore substations and export cables.	✓		*Design will meet MCA requirements.*
viii. Nacelle hatches and other OREI enclosed spaces in which	✓		*Design will meet MCA requirements.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
personnel are working 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.			
ix. 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 scenario should therefore be considered when identifying the optimum position of such ladders and take into account the prevailing wind, wave and tidal conditions.	✓		*Design will meet MCA requirements.*
x. 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.	✓		*Not applicable to offshore wind farm.*
2. Operational Requirements			
i. The Central Control Room, or mutually agreed single point of contact, should be manned 24 hours a day.	✓		*Design will meet MCA requirements.*
ii. The Central Control Room, 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, or individual devices in other types of OREI.	✓		*Design will meet MCA requirements.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
iii. All MRCCs will be advised of the contact telephone number of the Central Control Room, or mutually agreed single point of contact.	✓		*Design will meet MCA requirements.*
iv. All MRCCs will have a chart indicating the GPS position and unique identification number of each of the WTGs in all wind farms or all devices in other types of OREI.	✓		*Design will meet MCA requirements.*
v. All search and rescue helicopter bases will be supplied with an accurate chart of all the OREI and their GPS positions.	✓		*Design will meet MCA requirements.*
vi. The Civil Aviation Authority shall be supplied with accurate GPS positions of all OREI structures for civil aviation navigation charting purposes	✓		*Design will meet MCA requirements.*
3. Operational Procedures			
i. 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 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/SC 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 contact point, by the MRCC. A similar procedure will be followed when vessels are close to or within other types of OREI site.	✓		*Design will meet MCA requirements.*

Issue: OREI RESPONSE	Yes	No	Reference notes/Remarks
ii. The control room operator, or single point of contact, should immediately initiate the shut-down procedure for those WTGs as requested by the MRCC and maintain the WTG in the appropriate shut-down position, again as requested by the MRCC, or as agreed with MCA Navigation Safety Branch or Search and Rescue Branch for that particular installation, until receiving notification from the MRCC that it is safe to restart the WTG.	✓		*Design will meet MCA requirements.*
iii. 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	✓		*Design will meet MCA requirements.*
iv. Communication 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.	✓		*Design will meet MCA requirements.*

Offshore Renewable Energy Installations

Methodology for Assessing the Marine Navigational Safety Risks of Offshore Wind Farms - Compliance with recommended DTI Methodology.

General Comments:

Section	Yes	No	Reference notes/Remarks
A1: Overview and guidance on navigation safety issues.	✓		*Section 2: Guidance, Legislation and Consultation.*
A2: Overview of FSA.	✓		*Section 2: Guidance, Legislation and Consultation.* *Section 16: Formal Safety Assessment.*
A3: Lessons learned.	✓		*Section 4.6: Data Sources – Lessons Learned. Entire NRA takes into account Lessons Learned within the offshore industry.*
B1: Base case traffic densities and types.	✓		*Section 11: Maritime Traffic Surveys.* *Section 12: Fishing Vessel Activity.* *Section 13: Recreational Vessel Activity.*
B2: Future traffic densities and types.	✓		*Section 17: Risk Modelling and Assessment.*
B3: The marine environment :			
B3.1 Technical & operational analysis	✓		*Section 6: Project Description Details.*
B3.2 Generic TOA	✓		*Section 11: Maritime Traffic Surveys.*
B3.3 Potential accidents	✓		*Section 16: Formal Safety Assessment and Appendix A.* *Section 17: Risk Modelling and Assessment.*
B3.4 Affected navigational activities	✓		*Section 11: Maritime Traffic Surveys.* *Section 12: Fishing Vessel Activity.* *Section 13: Recreational Vessel Activity.* *Section 16: Formal Safety Assessment and Appendix A.* *Section 17: Risk Modelling and Assessment.*
B3.5 Effects of wind farm structures	✓		*Section 17: Risk Modelling and Assessment.*
B3.6 Development phases	✓		*Section 6: Project Description Details.*
B3.7 Other structures & features	✓		*Section 6: Project Description Details.* *Section 14: Cable Route Review.*
B3.8 Vessel types involved	✓		*Section 11: Maritime Traffic Surveys.* *Section 12: Fishing Vessel Activity.* *Section 13: Recreational Vessel Activity.* *Section 14: Cable Route Review.*
B3.9 Conditions affecting	✓		*Section 8: Metocean Data*

Section	Yes	No	Reference notes/Remarks
navigation			*Section 17: Risk Modelling and Assessment.*
B3.10 Human actions	✓		*Section 11: Maritime Traffic Surveys.* *Section 12: Fishing Vessel Activity.* *Section 13: Recreational Vessel Activity.* *Section 16: Formal Safety Assessment and Appendix A.*
C1: Hazard Identification	✓		*Section 16: Formal Safety Assessment and Appendix A.*
C2: Risk Assessment	✓		*Section 16: Formal Safety Assessment and Appendix A.*
C3: Hazard log	✓		*Section 16: Formal Safety Assessment and Appendix A.*
C4: Level of risk	✓		*Section 16: Formal Safety Assessment and Appendix A.*
C5: Influences on level of risk	✓		*Section 16: Formal Safety Assessment and Appendix A.* *Section 17: Risk Modelling and Assessment.*
C6: Tolerability of residual risk	✓		*Section 16: Formal Safety Assessment and Appendix A.*
D1 : Appropriate risk assessment	✓		*Entire NRA Document.*
D2 : MCA approval for assessment tools and techniques	✓		*Section 4: Data Sources.* *Section 16: Formal Safety Assessment and Appendix A.*
D3: Demonstration of results	✓		*Section 16: Formal Safety Assessment and Appendix A.*
D4 : Area traffic assessment	✓		*Section 11: Maritime Traffic Surveys.* *Section 12: Fishing Vessel Activity.* *Section 13: Recreational Vessel Activity.* *Section 14: Cable Route Review.*
D5 : Specific traffic assessment	✓		*Section 11: Maritime Traffic Surveys.* *Section 12: Fishing Vessel Activity.* *Section 13: Recreational Vessel Activity.* *Section 14: Cable Route Review.*
E1 : Risk control log	✓		*Section 16: Formal Safety Assessment and Appendix A.*
E2 : Cost benefit assessment	✓		*Section 16: Formal Safety Assessment and Appendix A.*
E3 : Assessment of equity to stakeholders	✓		*Assessment of equity to stakeholders will be carried out if required.*
F1: Tolerability of risk claim	✓		*Section 16: Formal Safety Assessment and Appendix A.*
G1 : Hazard identification	✓		*Section 16: Formal Safety Assessment and*

Section	Yes	No	Reference notes/Remarks
checklist			*Appendix A.*
G2 : Risk control checklist	✓		*Section 16: Formal Safety Assessment and Appendix A.*
G3 : MCA MGN 371 compliance checklist	✓		*Appendix C: MGN 371 Checklist.*

Offshore Wind Farm Vessels Historical Incident Review

Hywind Scotland Pilot Park

(Appendix D)

Prepared by:	Anatec Limited
On behalf of:	Xodus Group Limited on behalf of Hywind Scotland Limited
Date:	25 November 2014
Revision No.:	02
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1. Introduction

Experience in the oil and gas industry indicates visiting in-field (attendant) vessels have been responsible for the vast majority of vessel / structure collisions, including 549 out of 557 collisions (98.6%) on the UKCS between 1 January 1975 and 31 October 2001 (Ref.i). This is primarily because these support vessels spend much greater time working in proximity to structures and therefore the exposure level is much higher.

The consequences associated with in-field vessel impacts with oil & gas installations have generally tended to be less severe due to the size and speed of the vessels, although there have been notable exceptions such as the Mumbai High North collision in 2005 which resulted in 22 fatalities, and the Ekofisk collision in 2009 which had property damage estimated at $840m.

It is expected that this pattern of more frequent incidents but with average lower consequences will also apply to the offshore wind industry. To date, data has been lacking but this is now growing as experience increases and the industry works together to share experience and learn lessons.

This appendix summarises the latest available data on collision incidents with wind farms to inform this issue for the Hywind Scotland Pilot Project. Incident reports from the G9 are also summarised.

2. Incident Database

2.1 Data Sources

There is limited officially reported data on vessel collisions/contacts associated with offshore wind farm vessels.

For this review, incident data has been collated from a variety of sources including:

- Marine Accident Investigation Branch (MAIB)
- International Marine Contractors Association (IMCA)
- Federal Bureau of Maritime Casualty Investigation (BSU)
- Literature Review (including Web Search)

Information on G9 Offshore Wind Health and Safety Association (Ref ii) is presented separately in Section 3.

2.2 Incidents

Table 2.1 presents descriptions of few offshore wind farm collisions or contacts that have occurred across Europe, collated from a variety of sources outlined in Section 2.1.

Table 2.1 Vessel Collisions involving Offshore Wind Farms

Incident Type	Date	Description of Incident	Fatalities/Injuries	Source
Service Vessel Collision with OWT Structure	07-Aug-05	A vessel involved with the installation of offshore wind turbines at Kentish Flats 1, underestimated the effect of the current and made contact with the base of a wind turbine tower while manoeuvring alongside it. Minor damage was sustained to a gangway on the vessel, the tower and a wind turbine blade.	Minor damage to gangway on the vessel, the tower and a wind turbine blade.	MAIB
Service Vessel Collision with OWT Structure	29-Sep-06	When approaching an offshore wind turbine, to conduct servicing operations, an offshore support vessel was struck by the tip of a wind turbine blade. The accident occurred because the propeller was not secured in a fixed position, and was rotating as the vessel approached.	No damage to vessel and no injuries. Tip of blade was damaged.	MAIB
Service Vessel Collision with OWT Structure	08-Feb-10	An 18m fast CAT work boat was servicing a wind farm. Directly astern of the vessel was a test pile (now disused and no longer required), the position of which was well marked and known to skipper. While vessel was manoeuvring within about 3m of this pile, the skippers hand slipped on the throttle controls, pulling the port throttle to full astern. The skipper realised there was a problem, and quickly tried to stop the vessel from moving astern, but as the pile was so close, there was not time or room to do so. The vessel struck the pile, causing minor damage to the stern fenders and deck plating. The impact caused a passenger, who was moving around the interior to be thrown off his feet, and to fall against furniture and injure himself. The passenger injuries did not seem to be very serious at the time and he mounted the turbine to work as usual, but later reported sick and was taken to hospital where back injuries were diagnosed. Once the vessel was safely clear of the pile and the situation stabilised, the skipper checked around for further damage but no serious damage was found. No water ingressed.	35-39 year old male on duty strained his back due to collision and was taken to hospital	MAIB
Service Vessel Collision with	23-May10	Accident involving the shipboard heavy crane occurred on the WIND LIFT1, an installation vessel for offshore turbines, in the offshore wind	Three people on deck were slightly injured	Federal Bureau of

Incident Type	Date	Description of Incident	Fatalities/Injuries	Source
OWT Structure		farm "BARD 1" about 50nm NW of Borkum. At an elevation angle of 35 degrees and a height of about 40m, the iron pipe ("pile"), 85m long and 425 tonnes, slipped out of the hydraulic grab and fell with great force onto the deck of the vessel. The superstructure sustained heavy material damage. The piles direction of fall and that it occurred during midday when only few people were on deck prevented further, more severe consequences.	while trying to move to safety and/ falling due to vibration.	Maritime Casualty Investigation (BSU), Germany
Service Vessel Collision with Passing Vessel	23-Apr-11	Catamaran was hit by a wind farm guard boat, SB Seaguard. Wind Farm boat was working on the London Array project. The collision took place in Ramsgate harbour.	No injuries, major damage to catamaran	Web Search
Service Vessel Collision with OWT Structure	18-Nov-11	A cable laying vessel working in Sheringham Shoal wind farm suffered two hull breaches in way of a fresh tank and damage to the steel rubbing strake after it struck the foundations of a partially completed tower in the early hours of the morning. The subsequent company investigation found that the OOW had fallen asleep while on watch and woke to find the vessel inside the wind farm. He attempted to take the vessel out of the farm on autopilot but the settings were such that the ship did not turn quickly enough and the vessel made contact with the partially built structure. Nobody on the vessel felt the impact and the second officer deleted the passage on the ECDIS to avoid detection. However, when the crew woke the next morning, the mate found that the ship had lost 90t of fresh water and there was further cause for concern when the ship's potable water supply tasted salty. The ECDIS track was recovered and the second officer challenged. He eventually admitted what had happened and following the investigation, was dismissed from the ship.	Material Damage, no injuries	MAIB
Service Vessel Collision with Service Vessel	02-Jun-12	Nine Sheringham Shoal Offshore wind farm workers were safely evacuated from their personnel transfer vessel Opal into a life raft yesterday evening after their vessel became lodged under the boat landing equipment of the floating hotel Regina Baltica. The workers were returning to their accommodation on the "floatel" after their shift installing and	No Injuries	Web Search

Incident Type	Date	Description of Incident	Fatalities/Injuries	Source
		commissioning turbines when the incident occurred. A section of the Regina Baltica's boat landing equipment detached and the bow of the Opal was lodged underneath just as workers were preparing to transfer on-board. The life raft was deployed and all passengers were safely evacuated and transferred to a nearby vessel before being brought in to Wells-next-the-Sea.		
Service Vessel Collision with OWT Structure	20-Oct-12	A wind farm service vessel caused minor damage when the officers of the watch misjudged its distance from the monopile and made contact with the vessels stern at Gywnt y Mor Offshore Wind Farm site.	Minor Damage	MAIB
Service Vessel Collision with OWT Structure	21-Nov-12	Wind farm passenger transfer catamaran Windcat 9 support vessel struck a floating target at a speed of 23.5 knots, whilst supporting operations at Centrica's Lynn and Inner Dowsing wind farm. During the incident, the 15 member crew were forced to abandon the Windcat Workboats craft and the vessel was towed into Grimsby harbour. The port hull was holed, causing extensive flooding, but there were no injuries. The investigation found that the master did not hold the correct qualifications and that navigation practices, including passage planning and monitoring, use of lookouts and knowledge of the navigation equipment were weak. In addition, the company's crew assessment procedures were not followed and the master had not been formally assessed to determine his suitability for his role. It was also noted that best practice guidance for managers and crew of offshore renewable energy passenger transfer vessels was limited and disparate, and there was no integrated method of promulgating lessons learned to the industry.	No injuries, vessel hull holed and water ingress	MAIB
Service Vessel Collision with OWT Structure	21-Nov-12	The Island Shipping work boat Island Panther, collided head on with the unlit transition piece of turbine i-6 in the Sheringham Shoal offshore wind farm off the Yarmouth coast, at a speed of 12 knots. The impact caused the five persons on board to be forced out of their seats and sustain various injuries. A doctor was transferred to the vessel by lifeboat to treat the	Four crew members and a wind farm worker were injured.	MAIB

Incident Type	Date	Description of Incident	Fatalities/Injuries	Source
		injured personnel. The structure immediately aft of the vessels bow fender crumpled as a result of the impact but no water ingress occurred. The investigation determined that the accident occurred because the master had relied too heavily on visual cues and had made insufficient use of the lookout and navigation equipment available. There was insufficient training, particularly in regard to navigation equipment, and no formal assessment of new masters, allowing the possibility of ingrained poor working practices being passed on. Although the turbine transition piece had been reported as unlit, the system for reporting defects had failed to result in a navigation warning being promulgated. Although not formal aids to navigation, it was inevitable that the lights would be utilised as such.		
Service Vessel Collision with OWT Structure	16-Feb-13	A shipping accident occurred at the offshore wind farm Bard Offshore 1. An offshore service and supply vessel collided with one of the wind farm's turbine foundations, causing serious damage to the bow fender of the twin hulled vessel.	None of the six crew on board was hurt and seaworthiness of the vessel was only slightly damaged.	Web Search
Passing Vessel Collision with OWT Structure	09-Jun-13	Incident occurred where a yacht in Strangford Lough struck the surface piercing machine (SeaGen tidal turbine). A Portaferry lifeboat attended the incident.	No one was seriously injured	Web Search
Service Vessel Collision with OWT Structure	17-Jun-13	Accident occurred in Emden's Great Sea Lock in the early evening of June 17, when a composite of two Dutch tugboats and a pontoon collided with a dolphin structure. The towing composite was carrying three tripod foundations for construction of offshore wind turbines at Global Tech 1 offshore wind farm site.	No Injuries	Web Search
Service Vessel Collision with OWT Structure	July 2013	A wind farm service vessel collided with a turbine foundation, after failure of the vessel jet drive. The incident occurred after the vessel had disembarked passengers at the sub-station and had reversed away to drift, whilst standing by for the next assignment. The jets were disengaged and engines left running, as was common practice. Under the influence of	Damage to vessel	IMCA Safety Flash

Incident Type	Date	Description of Incident	Fatalities/Injuries	Source
		currents, the vessel drifted towards another turbine foundation and when approximately 30m away, the vessel coxswain/skipper attempted to engage the jets. At this moment it was found that neither jet would engage. Several minutes were spent fault finding to no avail, after which the vessel coxswain/skipper assisted the deckhand with fenders. The vessel collided with the foundation, causing a buckled frame and bent plate in the port quarter bulwark, but no damage to the foundation. It was found that there was no guidance from the wind farm operator on a minimum distance of approach to offshore structures while drifting. At the speed the wind farm vessel was drifting, 30m was not sufficient distance to allow enough time to restart the jets or to anchor.		
Standby Vessel Collision with OWT Structure	14-Aug-2014	An accident occurred at Walney Wind Farm, off Barrow-in-Furness when a standby safety vessel, OMS Pollux, collided with a turbine pile. The accident caused the vessel to leak marine gas oil and a surface sheen, 5-10 metres wide and around 0.7 nautical miles in length trailed from the vessel. The standby vessel moved under its own power to a location outside the Liverpool Port Authority limits, away from environmentally sensitive areas until the leak was stopped.	No reported injuries	Web Search

3. G9 Records

3.1 Introduction

G9 Offshore Wind Health and Safety Association was founded in 2010 by nine offshore wind developers. The founder member companies are Centrica, DONG Energy, E.ON, RWE Innogy, Scottish Power Renewables, SSE, Statkraft, Statoil and Vattenfall. The primary aim of the G9 is to promote strong health and safety culture across all of its activities in the offshore wind industry.

Any accident or incident occurring within offshore wind industry are listed and discussed on regular basis by the member companies of G9 to have a better picture of the associated risks and to find the possible mitigations actions to prevent further accidents.

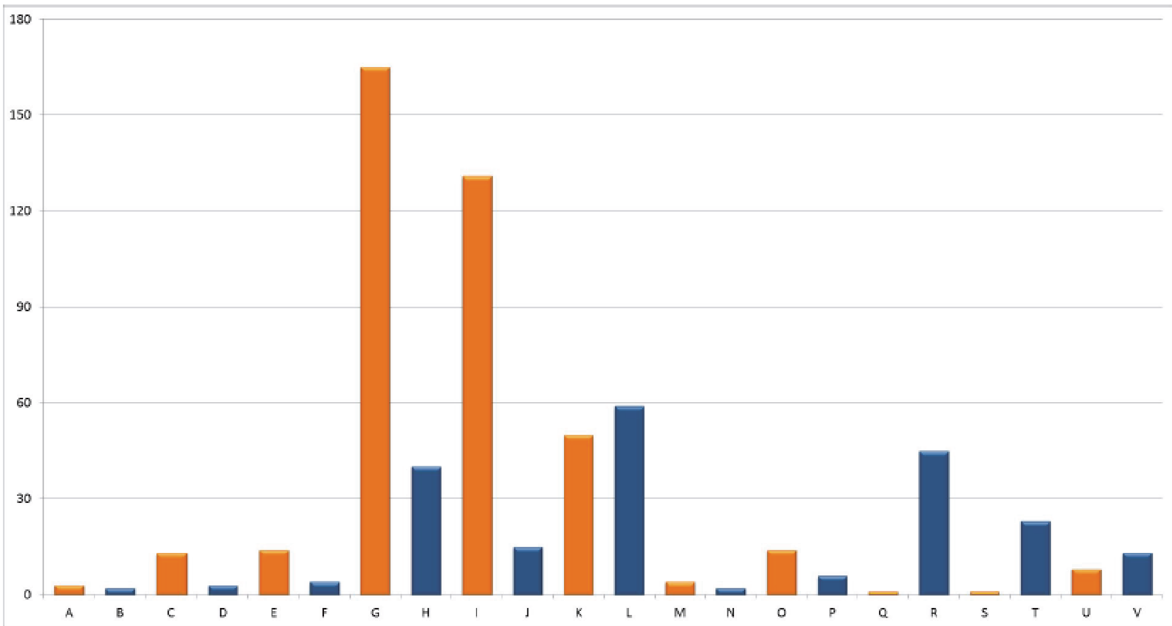
According to G9 Offshore Wind Health and Safety Association, there have been 166 reported incidents from January 2011 – July 2012 and 616 incidents in 2013. The data has been collected by each G9 member site and has subsequently been categorised into operation and project phases and incident areas by G9 Board Group. The breakdown of incidents that occurred in 2013 has been outlined below. The incidents associated with the marine operations have been emphasised.

3.2 Incidents Based on Incident Area

The breakdown of incidents based on incident area shows that the majority of the incidents occurred on vessels (46%), followed by turbines (29%) and at onshore facilities (20%). The incidents that occurred at turbines mainly took place at the turbine tower, nacelle, the transition piece area and at hub and blades. The onshore activities included incidents at harbour, quay and pontoons and at excavations and civil site areas. A small number of incidents have occurred at offshore facilities such as met mast and substation work and cable areas. Around 48% of the lost work day incidents occurred on vessels.

3.3 Incidents and Consequences Based on Work Process

The majority of incidents occurred during lifting operations under operational phase (site under operation), marine operations and project phase (development, construction and commissioning) of the plant and machinery as presented in Figure 1.



Key					
A	Business travels	I	Marine operations*	Q	Transfer by helicopter
B	Catering/cleaning	J	Office work	R	Working at heights
C	Civil works	K	Operating plant and machinery	S	Working in confined spaces
D	Diving operations	L	Other	T	Working on energised systems
E	Facility management	M	Replacing major components	U	Working with chemicals and hazardous substances
F	Hot works	N	Rigging/slinging	V	Working with hand tools/power tools
G	Lifting operations	O	Surveys		
H	Manual handling	P	Training/drills/team building events		

Figure 1 Breakdown of Incidents Based on Work Process

Of 66 total lost work day incidents reported, the highest number of incidents occurred during the manual handling activities, lifting operations, operating plant and machinery and during marine operations. Descriptions of the top three processes of highest risk are presented below. Incidents association with marine operations are detailed further.

- Lifting Operations - There were 165 incidents which occurred during the lifting operations with 120 incidents occurring on operational sites and the remaining on project sites. 63% of all incidents occurred on vessels, followed by lifting operations on the harbour, quay and pontoon and the transition piece area. Of 165 incidents, 108 were near hits, 22 hazards and 9 lost work day incidents.
- Working at height – 45 incidents were recorded when working at height with 31% that occurred in the turbine tower, 16% in the hub and blades and 13% on met masts. There were 36 near hits, four hazards and one lost work day incident recorded.
- Marine Operations – A recorded number of 131 incidents occurred during marine operations with 84 occurring on operational sites and 47 on project sites. Marine operations include maritime operations; transfer by vessel, vessel operations and vessel mobilization with majority of 81% incidents that occurred on vessel themselves. The breakdown of incident consequence during marine operations is shown in Figure 2.

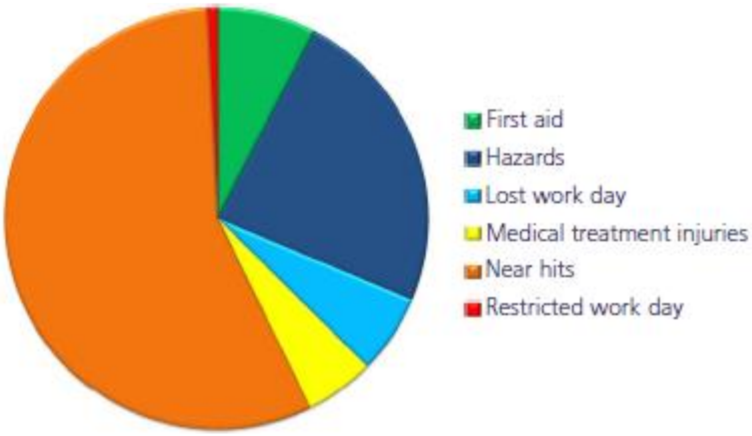


Figure 2 Marine Operations – Incident Consequence

It can be seen that the majority were near hits (56%) and followed by potential hazards (24%). There were a total of eight incidents resulting in lost work days.

The breakdown of incidents based on incident area is presented in Figure 3.

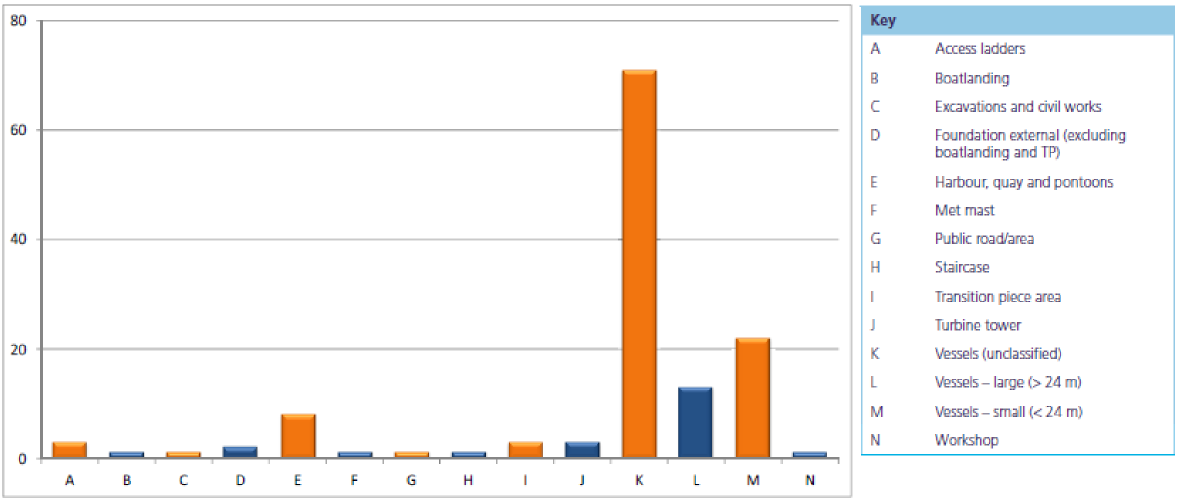


Figure 3 Marine Operations – Incident Area Breakdown

The majority of the incidents occurred within the unclassified vessels (54%), small vessels (17%) and followed by large vessels (10%).

4. Conclusion

There has been a lack of data on vessel collisions/contacts associated with offshore wind farm vessels to date.

From the review of available historical data, there have been no incidents with serious consequences such as fatalities or significant marine pollution.

The G9 initiative will help ensure a more comprehensive data set is available for future analysis of the risks associated with offshore wind industry vessel operations.

5. References

i Ship/Platform Collision Incident Database, HSE, 2003.

ii G9 Offshore Wind Health and Safety Association 2013. *G9 Offshore wind health and safety association 2013 annual incident data report*. Available from http://www.g9offshorewind.com/hse-statistics