Dudgeon and Sheringham Shoal Offshore Wind Farm Extensions

Preliminary Environmental Information Report

Volume 1

Chapter 15 - Shipping and Navigation

April 2021

China Resources
Better Life Together

Masdar
A MUBADALA COMPANY

equinor

Title**:**	
Dudg15 eon and Sheringham Shoal Offshore Wind Farm Extensions **Preliminary Environmental Information Report** **Chapter Other Marine Users**	
Document no.: PB8164-RHD-ZZ-XX-RP-Z-0010	
Date:	Classification
29th April 2021	**Final**
Prepared by: **Royal HaskoningDHV**	
Approved by: **Magnus Eriksen, Equinor**	Date: 29th April 2021

Table of Contents

15 SHIPPING AND NAVIGATION 9
15.1 Introduction 9
15.2 Consultation 10
15.3 Scope 23
15.4 Impact Assessment Methodology 33
15.5 Existing Environment 42
15.6 Potential Impacts 48
15.7 Cumulative Impacts 68
15.8 Transboundary Impacts 75
15.9 Inter-relationships 76
15.10 Interactions 78
15.11 Potential Monitoring Requirements 78
15.12 Assessment Summary 79
15.13 References 92

List of Tables

Table 15.1: Consultation responses. 10
Table 15.2: Realistic Worst Case Scenarios. 24
Table 15.3: NPS Assessment Requirements. 34
Table 15.4: Available data and information sources. 37
Table 15.5 Definition of frequency of occurrence on shipping and navigation receptor 39
Table 15.6 Definition of severity of consequence on shipping and navigation receptor 40
Table 15.7 Impact matrix 41
Table 15.8 Definition of impact significance 41
Table 15.9 Main Routes within the Study Area 47
Table 15.10: Collision rates in isolation 60
Table 15.11 Collision rates for DEP and SEP together 60
Table 15.12: Allision rates in isolation post windfarm 62
Table 15.13: Allision rates together post windfarm 63
Table 15.14 Potential Cumulative Impacts (impact screening) 68
Table 15.15: Summary of projects considered for the CIA 72
Table 15.16 Shipping and navigation users inter-relationships 76
Table 15.17: Interaction between impacts - screening 78
Table 15.18: Summary of potential impacts in EIA terms on shipping and navigation receptors 81

List of Plates

Plate 15-1: Main Routes within the Study Area 47
Plate 15-2: Vessel traffic survey data 50
Plate 15-3: Reduction in Available Searoom 61

Volume 2

Figure 15.1 Study Area

Volume 3

Appendix 15.1 15.1 Draft Navigation Risk Assessment

Glossary of Acronyms

ALARP	As Low as Reasonably Practicable
AtoN	Aids to Navigation
AIS	Automatic Identification System
BMAPA	British Marine Aggregate Producers Association
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CA	Cruising Association
CIA	Cumulative Impact Assessment
CGOC	Coastguard Operation Centres
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
CoS	Chamber of Shipping
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DEP	Dudgeon Extension Project
DfT	Department for Transport
DML	Deemed Marine Licence
DOW	Dudgeon Offshore Wind Farm
DSC	Digital Selective Calling
EIA	Environmental Impact Assessment
ERCoP	Emergency Response Co-operation Plans
ES	Environmental Statement
EU	European Union
EEZ	Exclusive Economic Zone
EEA	European Economic Area
FSA	Formal Safety Assessment
GIS	Geographical Information System
HDD	Horizontal Directional Drilling
HMCG	Her Majesty's Coastguard
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHO	International Hydrographic Organisation
IMO	International Maritime Organization
km	Kilometre

MAIB	Maritime Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MEHRA	Marine Environmental High Risk Areas
MW	Megawatts
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NSIP	Nationally Significant Infrastructure Project
OREI	Offshore Renewable Energy Installations
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
RAM	Restricted in Ability to Manoeuvre
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
SAR	Search and Rescue
SEP	Sheringham Shoal Extension Project
SNS	Southern North Sea
SOLAS	Safety of Life at Sea
SoS	Secretary of State
TEU	Treaty of the European Union
TSS	Traffic Separation Scheme
UK	United Kingdom
VHF	Very High Frequency
WTG	Wind Turbine Generator

Glossary of Terms

Allision	The act of striking or collision of a moving vessel against a stationary object.
Applicant	Equinor New Energy Limited
Array cables	See infield cables
Base Case	The assessment of risk based on current shipping densities and traffic types as well as the marine environment.
Collision	The act or process of colliding (crashing) between two moving objects.
Dudgeon Offshore Wind Farm Extension site	The Dudgeon Offshore Wind Farm Extension offshore wind farm boundary.
The Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks associated with the shipping activity.
Future Case	An assessment of future traffic trends by assuming a set increase in vessel numbers on identified routeing within the area.
Grid option	Mechanism by which DEP and SEP will connect to the existing electricity network. This may either be an integrated grid option providing transmission infrastructure which serves both of the wind farms, or a separated grid option, which allows DEP and SEP to transmit electricity entirely separately.
Infield cables	Cables which link the wind turbine generators to the offshore substation platforms
Interlink cables	Cables linking two separate project areas. This can be cables linking: 1. DEP South and DEP North 2. DEP South and SEP 3. DEP North and SEP 1 is relevant if DEP is constructed in isolation or first with a separated grid option. 2 and 3 are relevant with an integrated grid option.
Landfall	The point at the coastline at which the offshore export cables are brought onshore, connecting to the onshore cables at the transition joint bay above mean high water
Offshore cable	Any offshore cable including infield cables, interlink cables and offshore export cables.

Offshore cable corridor	An area which will contain cables outside of a wind farm site(s), either interlink cables or offshore export cables.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency which provide significant advice relating to the improvement of the safety of shipping and of life at sea, and to prevent or minimise pollution from shipping.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall (220 – 230kV).
Offshore substation platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Safety Zone	A marine zone outlined for the purposes of safety around a possibly hazardous installation or works / construction area under the Energy Act 2004.
Study area	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
Sheringham Shoal Offshore Wind Farm Extension site	Sheringham Shoal Offshore Wind Farm Extension offshore wind farm boundary.
The Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension site as well as all onshore and offshore infrastructure.
Traffic Separation Scheme (TSS)	A traffic-management route-system ruled by the International Maritime Organization.

15 SHIPPING AND NAVIGATION

15.1 Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) considers the potential impacts of the proposed Dudgeon Extension Offshore Wind Farm Project (DEP) and Sheringham Shoal Extension Offshore Wind Farm Project (SEP) on shipping and navigation. The chapter provides an overview of the existing environment for the proposed offshore development area, followed by an assessment of the potential impacts and associated mitigation for the construction, operation, and decommissioning phases of DEP and SEP.
2. This chapter has been written by Royal HaskoningDHV, with the assessment undertaken with specific reference to the relevant legislation and guidance. In line with legislation, a Navigational Risk Assessment (NRA) and Formal Safety Assessment (FSA) has also been undertaken (**Appendix 15.1**) by Anatec Limited (Anatec), preliminary at this stage, which is referred to in the chapter. Details of relevant legislation and guidance considered in this chapter, such as the National Policy Statements (NPS) and methodology used for the Environmental Impact Assessment (EIA) and Cumulative Impact Assessment (CIA) are presented in **Section 15.4**.
3. The assessment should be read in conjunction with the following linked chapters:
   - **Chapter 14 Commercial Fisheries**;
   - **Chapter 17 Aviation and MoD**; and
   - **Chapter 18 Petroleum Industry and Other Marine Users**.
4. As highlighted above, additional information used to support the shipping and navigation assessment includes:
   - NRA (preliminary) – A document primarily following Marine Guidance Note (MGN) 543 (MCA, 2016) MCA (2013) that provides detail on the existing and future navigational activity. This document is found in **Appendix 15.1** and will be fully completed post PEIR in line with MGN 543 requirements, noting that the MGN 543 checklist will be completed and the hazard workshop undertaken post PEIR.
   - FSA (preliminary) – The key output of the NRA following (International Maritime Organization (IMO) (IMO, 2018) guidance which follows a structured and systematic process for assessing risk. This assessment is presented within the NRA document in **Appendix 15.1** and will be fully completed post PEIR in line with MGN 543 requirements.

15.2 Consultation

5. Consultation to date with regard to shipping and navigation has been undertaken in line with the general process described in **Chapter 6 EIA Methodology**. The key elements to date have included scoping and, as part of the NRA, targeted consultation with stakeholders and regular users in proximity to DEP and SEP and in line with requirements set out in the Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI) (MCA, 2013). The feedback received has been considered in preparing the PEIR. **Table 15.1** provides a summary, reflective of that presented in the NRA, of how the consultation responses received to date have influenced the approach that has been taken.

6. Additional consultation with stakeholders and regular users will be continued post PEIR and this chapter will be updated following the consultation on the PEIR in order to produce the final assessment that will be submitted with the Development Consent Order (DCO) application. Full details of the consultation process will also be presented in the Consultation Report alongside the DCO application.

Table 15.1: Consultation responses.

Consultee	Date / Document	Comment	Project Response
The Planning Inspectorate	Scoping Opinion, 19/11/19	The Inspectorate welcomes that any impacts from proposed dredger transit activities will be assessed as part the Shipping and Navigation aspect.	Impacts from proposed dredger transit is addressed in **Section 15.6**.
The Planning Inspectorate	Scoping Opinion, 19/11/19	The Inspectorate considers that given the location of the Proposed Development, significant transboundary effects to other marine users are unlikely and that this matter can be scope out of the ES. This is on the basis that transboundary impacts on commercial fishing and shipping and navigation are assessed in their respective aspect chapters.	Transboundary effects have been considered in **Chapter 14 Commercial Fisheries** and **Section 15.8** in line with the Planning Inspectorate's recommendations.
Secretary of State (SOS)	Scoping Opinion, 19/11/19	EIA should assess impacts to marine navigation equipment, marine aggregate dredger transits, and adverse weather routeing. Impacts to navigation from scour / sediment transport should also be assessed.	Effects are assessed within **Section 15.6** and within the NRA (**Appendix 15.1**).

Consultee	Date / Document	Comment	Project Response
SoS	Scoping Opinion, 19/11/19	10% increase in (future case) traffic should be justified.	The NRA has considered potential increases of 10 and 20% which are also used in the assessment within this chapter (**Section 15.6**).
SoS	Scoping Opinion, 19/11/19	Shipping and Navigation and Commercial Fishing chapters to state what "size" of safety zones will be used	Safety Zones that are expected to be applied for are detailed in **Chapter 5 Project Description**.
MCA	Scoping Opinion, 19/11/19	Given significant amount of through traffic to major ports, and a number of important shipping routes in close proximity, attention needs to be paid to routeing, particularly in heavy weather ensuring shipping can continue to make safe passage without large-scale deviations	Post wind farm routeing is assessed in **Section 15.6** and within the NRA (**Appendix 15.1**) including consideration of adverse weather.
MCA	Scoping Opinion, 19/11/19	A Navigational Risk Assessment will need to be submitted in accordance with MGN 543 (and MGN 372) and the MCA Methodology for Assessing the Marine Navigation Safety & Emergency Response Risks of OREI. Should include MGN 543 Checklist.	The NRA (**Appendix 15.1**) complies with the stated guidance and includes completed MGN 543 checklist.

Consultee	Date / Document	Comment	Project Response
MCA	Scoping Opinion, 19/11/19	Cumulative and in combination effects[1] on shipping routes should be considered, taking into account proximity to other windfarm developments, the impact on navigable sea room and include an appropriate assessment of the distances between wind farm boundaries and shipping routes as per MGN 543.	Post wind farm routeing is assessed in **Section 15.6**. Cumulative assessment of routeing is provided in **Section 15.7**.
MCA	Scoping Opinion, 19/11/19	A vessel traffic survey will be undertaken to the standard of MGN 543. This must consist of at least 28 days and include seasonal data (two x 14-day surveys) collected from a vessel-based survey using Automatic Identification System (AIS), radar and visual observations to capture all vessels navigating in the study area.	The approach to marine traffic data collection has been agreed with the MCA which includes two (winter and summer) 14 day surveys.
MCA	Scoping Opinion, 19/11/19	The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and Search and Rescue (SAR) aircraft operating within the site. As such, MCA will seek to ensure all structures are aligned with the current layout designs of Dudgeon and Sheringham Shoal wind farms, in straight rows and columns, and with at least two lines of orientation. Any additional navigation safety and/or SAR requirements, as per MGN 543 Annex 5, will be agreed at the approval stage.	The layout and SAR requirements will be agreed with the MCA (as per MGN 543 with consideration as to the Design Rules) and MMO post consent via the Deemed Marine Licence (DML) which would form part of the Development Consent Order (DCO).

[1] In combination effects for shipping and navigation are considered to be the same as cumulative.

Consultee	Date / Document	Comment	Project Response
MCA	Scoping Opinion, 19/11/19	Attention should be paid to cabling routes and where appropriate burial depth for which a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary. If cable protection are required e.g. rock bags, concrete mattresses, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum. This will be particularly relevant where depths are decreasing towards shore and potential impacts on navigable water increase.	A Cable Burial Risk Assessment will be undertaken to determine cable protection requirements, which will be part of the Deemed Marine Licence (DML) and in full MGN 543 compliance in all regards, including changes to water depths.
MCA	Scoping Opinion, 19/11/19	Particular consideration will need to be given to the implications of the site size and location on SAR resources and Emergency Response Co-operation Plans (ERCoP). Attention should be paid to the level of radar surveillance, AIS and shore-based Very High Frequency (VHF) radio coverage and give due consideration for appropriate mitigation such as radar, AIS receivers and in-field, Marine Band VHF radio communications aerial(s) (VHF voice with Digital Selective Calling (DSC)) that can cover the entire wind farm sites and their surrounding areas. A SAR checklist will also need to be completed in consultation with MCA.	The layout and any SAR requirements will be agreed with the MCA post consent. This will include the completion of a SAR checklist as required under MGN 543.

Consultee	Date / Document	Comment	Project Response
MCA	Scoping Opinion, 19/11/19	MGN 543 Annex 2 requires that hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard, with the final data supplied as a digital full density data set, and survey report to the MCA Hydrography Manager.	Equinor will comply with all aspects of MGN 543, including hydrographic survey requirements.
Ministry of Defence (MOD)	Scoping Opinion, 19/11/19	The Scoping Report makes reference to the lighting of the Dudgeon OWF and the MOD's Lighting Guidance is listed as a data source. In the interests of air safety, the DEP and SEP areas should be fitted with MOD accredited aviation safety lighting in accordance with the Air Navigation Order 2016. The MOD would need to confirm the specification of the lighting to be used.	Lighting and marking will be agreed with all relevant stakeholders and considering IALA O-130 (IALA, 2013) post consent. The MOD's lighting guidance is referenced in **Chapter 17 Aviation and MoD**.
Trinity House	Scoping Opinion, 19/11/19	NRA should include: Comprehensive vessel traffic analysis in accordance with MGN 543. The possible cumulative and in-combination effects on shipping routes and patterns should be fully assessed, with particular reference to the current operational Dudgeon, Sheringham Shoal and Race Bank OWFs. Any proposed layouts should conform with MGN 543 and again consideration should be given to the layouts of the current Dudgeon and Sheringham Shoal OWFs. The SEP layout should align with the current site, however, as the Dudgeon OWF site has a less uniform layout, early consideration surrounding	Marine traffic analysis in accordance with MGN 543 is presented in the NRA (**Appendix 15.1**). Cumulative assessment of routeing is provided in **Section 15.7** and the NRA (**Appendix 15.1**).

Consultee	Date / Document	Comment	Project Response
		the DEP layout and risk mitigation measures will be required. If any structures, such as met masts, offshore platforms, accommodation platforms or other transmission assets, lie outwith the actual wind farm turbine layout, then additional risk assessment should be undertaken.	The layout and any SAR requirements will be agreed with the MCA post consent.
Trinity House	Scoping Opinion, 19/11/19	The wind farms need to be marked with marine Aid to Navigation (AtoN) by the developer in line with IALA Recommendation O-139. Noted that buoys may be necessary in addition to structure marking, particularly during the construction phase. All marine navigational marking (required to be provided and maintained by the developer) should be agreed with Trinity House. This will include meeting availability requirements and the reporting thereof.	Lighting and marking will be defined in agreement with Trinity House and in line with IALA O-139. All availability and reporting requirements will be met.
Trinity House	Scoping Opinion, 19/11/19	Any monitoring equipment, including met masts and LIDAR or wave buoys must also be marked as required by Trinity House.	Lighting and marking will be defined in agreement with Trinity House.

Consultee	Date / Document	Comment	Project Response
Trinity House	Scoping Opinion, 19/11/19	A decommissioning plan, which includes a scenario where on decommissioning and on completion of removal operations an obstruction is left on site (attributable to the wind farm) which is considered to be a danger to navigation and which it has not proved possible to remove, should be considered. Such an obstruction may require to be marked until such time as it is either removed or no longer considered a danger to navigation, the continuing cost of which would need to be met by the developer/operator.	A decommissioning plan will be developed which will include consideration of the highlighted scenario.
Trinity House	Scoping Opinion, 19/11/19	The possible requirement for navigational marking of the export cables and the vessels laying them. If it is necessary for the cables to be protected by rock armour, concrete mattresses or similar protection which lies clear of the surrounding seabed, the impact on navigation and the requirement for appropriate risk mitigation measures needs to be assessed.	A Cable Burial Risk Assessment will be undertaken to determine cable protection requirements. Impacts from under keel clearance are addressed in **Section 15.6** and the NRA (**Appendix 15.1**).
MCA / Trinity House	Meeting 25/09/18	Irregular areas, i.e., area divided in several smaller shapes represents challenges with respect to lighting and marking.	The final layout will be agreed with MCA post consent, including the need for any additional mitigation. Lighting and marking will be agreed with all key stakeholders including Trinity House and MCA.

Consultee	Date / Document	Comment	Project Response
MCA / Trinity House	Meeting 25/09/18	Preference for extensions to be one area as supposed to several.	The final layout will be agreed with MCA post consent, including the need for any additional mitigation.
MCA / Trinity House	Meeting 25/09/18	Preference for layout which has a minimum of two lines of orientation, with turbines in straight lines. Alignment issues between Dudgeon and extension were noted in this regard.	The final layout will be agreed with MCA post consent, including the need for any additional mitigation.
MCA / Trinity House	Meeting 25/09/18	MCA and Trinity House stated required dimensions of shipping corridors should be calculated as per MGN 543 Annex 3.	Assessments of available sea room (**Section 15.6**) is calculated as per MGN 453 guidance (as detailed in **Appendix 15.1**).
MCA / Trinity House	Meeting 25/09/18	Noted that a "first come first serve" principle in place regarding assessment of cumulative effects towards other lease holders.	A “tiered” approach to cumulative assessment has been undertaken in the NRA and applied within **Section 15.7**.
MCA / Trinity House	Virtual Meeting 15/06/20	MCA stated good to see rows and columns of structures with no isolated / protruding turbines within the indicative layouts shown.	The final layout will be agreed with the MCA post consent and will comply with the Layout Rules.

Consultee	Date / Document	Comment	Project Response
MCA / Trinity House	Virtual Meeting 15/06/20	In terms of SAR, alignment, and lighting / marking perspectives, there was greater concern over DEP than SEP.	The final layout will be agreed with the MCA post consent and will comply with the Layout Rules. Lighting and marking will be agreed with all key stakeholders including MCA and Trinity House.
MCA / Trinity House	Virtual Meeting 15/06/20	MGN 543 update referenced by MCA, but agreed current version will be considered, noting no notable changes expected.	The NRA complies with MGN 543.
MCA / Trinity House	Virtual Meeting 15/06/20	MCA and Trinity House both content with impacts to be assessed (which have been identified based on Scoping Report and subsequent Scoping Opinion).	The identified potential impacts are assessed in **Section 15.6**.
MCA / Trinity House	Virtual Meeting 15/06/20	MCA and Trinity House content with proposed approach to marine traffic data (summer 2020 survey supplemented with long term data and consultation; additional survey late 2020 / early 2021).	Agreed approach detailed in **Section 15.4** and **Appendix 15.1**.
MCA / Trinity House	Virtual Meeting 15/06/20	Trinity House noted some alterations to operational lighting and marking of existing sites may be necessary to account for the extensions.	Lighting and marking will be agreed with all key stakeholders including Trinity House.
MCA / Trinity House	Virtual Meeting 15/06/20	MCA noted that as required under MGN 543, radio surveys should be undertaken pre and post construction for the extension projects.	There will be full MGN 543 compliance.
Cruising Association (CA)	Virtual Meeting 17/09/20	Content with approach to NRA and marine traffic data.	NRA provided in **Appendix 15.1**.

Consultee	Date / Document	Comment	Project Response
Cruising Association (CA)	Virtual Meeting 17/09/20	Concerns over increases / squeezing of traffic between the extension projects leading to rise in encounters / collision risk to recreational vessels. Noted that traffic in the area would be coming in bands associated with tidal times in the Humber.	Collision risk is assessed within **Section 15.6**.
Cruising Association (CA)	Virtual Meeting 17/09/20	Queries over effect of COVID situation on July / Aug 2020 traffic survey.	The approach to marine traffic data collection has been agreed with the MCA, and includes consideration of additional data sources (including long term pre-COVID marine traffic data).
Cruising Association (CA)	Virtual Meeting 17/09/20	Queried potential for any routeing measures in the area to assist with traffic management, and noted that marked routes (using buoyage) were helpful.	Appropriate mitigation in relation to increased encounters and collision risk will be discussed (as per **Section 15.6** and **Appendix 15.1**).
RYA	Virtual Meeting 30/09/20	Content with approach to NRA and marine traffic data.	Agreed approach detailed in **Appendix 15.1** and used to inform this chapter.
RYA	Virtual Meeting 30/09/20	Concerns for these sites were generally around under keel clearance and snagging.	Underkeel clearance is assessed and cable interaction is assessed within **Section 15.6** and **Appendix 15.1**.

Consultee	Date / Document	Comment	Project Response
RYA	Virtual Meeting 30/09/20	Queries over whether MGN 543 will be utilised as it stands. It was confirmed this was the case given the updates have not yet been confirmed / published.	The NRA complies with MGN 543 (latest version available).
RYA	Virtual Meeting 30/09/20	Noted the importance of considering both elements (density grids and boating areas) of the RYA Coastal Atlas and to be aware the density grids are based on AIS only.	The RYA Coastal Atlas has been considered in full to establish the baseline in terms of recreational traffic, features, and facilities.
RYA	Virtual Meeting 30/09/20	Pleased to see that the summer survey was undertaken in July and August and was content with the marine traffic survey approach.	Agreed data collection detailed in **Section 15.4**.
RYA	Virtual Meeting 30/09/20	Noted that recreational vessels were currently transiting in areas used by commercial vessels (i.e., area between the sites) and extensions may therefore increase collision risk.	Collision risk is assessed within **Section 15.6** and the NRA (**Appendix 15.1**).
Virtual meeting with Chamber of Shipping (CoS)	30/09/20	Queried alignment with the existing turbines.	The final layout will be agreed with the MCA post consent and will comply with the Layout Rules.
Virtual meeting with Chamber of Shipping (CoS)	30/09/20	Queried whether any future updates to MGN 543 would be incorporated / complied with noting these updates are out for consultation. Content with approach to NRA and marine traffic data.	Agreed approach detailed in **Appendix 15.1**. The NRA will comply with latest version of MGN 543 available at the time of completion of the final NRA.

Consultee	Date / Document	Comment	Project Response
Virtual meeting with Chamber of Shipping (CoS)	30/09/20	Pleased to see that seasonal variation (or lack thereof) was being captured via the assessment of 12 months of AIS to supplement the marine traffic survey data.	Agreed data collection is detailed in **Section 15.4**.
Virtual meeting with Chamber of Shipping (CoS)	30/09/20	Queried whether marine aggregate dredging presence in the area would be assessed, and whether the British Marine Aggregate Producers Association (BMAPA) routes would be considered.	Assessed within **Section 15.6** and the NRA (**Appendix 15.1**).
Virtual meeting with Chamber of Shipping (CoS)	30/09/20	Queried whether post wind farm routeing would consider both sites being built.	The scenario where both sites are built has been assessed within **Section 15.6** and the NRA (**Appendix 15.1**).
DFDS (commercial ferries)	Request letter (09/20) response	The area is utilised by DFDS vessels on adverse weather routes, but no significant impacts are expected.	Assessed within **Section 15.6** and the NRA (**Appendix 15.1**).
Furetank	Request letter (09/20) response	Queried what safety zones would be utilised.	Safety Zones that are expected to be applied for are detailed in **Chapter 5 Project Description**.
Whitaker Tankers	Request letter (09/20) response	No impacts are expected.	Noted.
Sentinel	Request letter (09/20) response	Stated no comments on the project.	Noted.

Consultee	Date / Document	Comment	Project Response
P&O	Request letter (09/20) response	Noted that routes would require to deviate to avoid the SEP wind farm site, and that this would lead to increased distance and fuel costs.	Deviation / displacement impacts are assessed within **Section 15.6** and the NRA (**Appendix 15.1**).
Boston Putford	Request letter (09/20) response	Noted that routes would be required to deviate and that this may cause increases in levels of traffic in other areas. Also, the site is particularly close to the Perenco Waveney platform and could cause restricted access to this platform. Indicated that Boston Putford vessels would likely not transit through the array.	Deviation / displacement impacts are assessed within **Section 15.6** and the NRA (**Appendix 15.1**). Access / proximity impacts associated with O&G assets are assessed within **Section 15.6** and **Chapter 18 Petroleum Industry and Other Marine Users.**
Essberger	Request letter (09/20) response	Deviations will be limited on an individual basis, but will have cumulative effect in terms of emissions. Further, the deviations may lead to a concentration of shipping activity in certain areas, leading to increased collision risk.	Impacts are assessed within **Section 15.6** and the NRA (**Appendix 15.1**).
Stena Lines	Request letter (09/20) response	Certain routeing will be required to deviate, and the reduction in sea room may lead to increased collision risk. Indicated that Stena vessels would not transit through the array.	Impacts are assessed within **Section 15.6** and the NRA (**Appendix 15.1**).
GEFO	Request letter (09/20) response	Anticipate limited / manageable deviation.	Impacts are assessed within **Section 15.6** and the NRA (**Appendix 15.1**).

15.3 Scope

15.3.1 Study Area

7. The study area for this assessment is defined as a 10nm buffer of the wind farm sites and a 2nm buffer of the offshore export cable corridor to ensure that all relevant passing traffic is captured in the assessment. The buffers are shown in **Figure 15.1**, which shows the collective study area (incorporating all buffers) as well as that for DEP and SEP separately.

8. Further, where relevant the assessment also considers existing, as well as planned projects and activities, where information is within the planning system, otherwise publicly available, or has been made available through the consultation process within 100nm of the wind farm sites.

15.3.2 Realistic Worst Case Scenario

15.3.2.1 General Approach

9. The final design of DEP and SEP will be confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. In order to provide a precautionary but robust impact assessment at this stage of the development process, realistic worst case scenarios have been defined in terms of the potential effects that may arise. This approach to EIA, referred to as the Rochdale Envelope, is common practice for developments of this nature, as set out in Planning Inspectorate Advice Note Nine (2018). The Rochdale Envelope for a project outlines the realistic worst case scenario for each individual impact, so that it can be safely assumed that all lesser options will have less impact. Further details are provided in **Chapter 6 EIA Methodology**.

10. The realistic worst case scenarios for the shipping and navigation assessment are summarised in **Table 15.2**. This also reflects the maximum design scenario used within the NRA and FSA (**Appendix 15.1**). These are based on the project parameters described in **Chapter 5 Project Description**, which provides further details regarding specific activities and their durations.

11. In addition to the design parameters set out in **Table 15.2**, consideration is also given to how DEP and SEP will be built out as described in **Section 15.3.2.3** to **Section 15.3.2.5** below. This accounts for the fact that whilst DEP and SEP are the subject of one DCO application, it is possible that either one or both DEP and SEP will be developed, and if both are developed, that construction may be undertaken either concurrently or sequentially. In the case of the shipping and navigation assessment, concurrent development is considered to be the worst case project together scenario and as such the sequential project scenario is not discussed in detail.

Table 15.2: Realistic Worst Case Scenarios.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
Construction				
Vessel displacement, collision and allision	**Wind farm site:** Two wind farm sites (DEP North and South) totalling **103.50km²** Installation of up to **32 x 14 MW wind turbines** and **one offshore substation platform** (OSP) in DEP North **Offshore cables:** Up to **267km** of cables comprising: • One HVAC export cable up to **62km** in length • **135km** of infield cables (DEP North:	**Wind farm site** One wind farm site totaling **92.6km²** Installation of up to **24 x 14MW wind turbines** and **one OSP** in SEP **Offshore cables:** Up to **130km** of cables comprising: • One HVAC export cable up to **40km** in length • **90km** of infield cables • No interlink cables • Burial depth: Same as DEP in isolation	**Wind farm sites** Three farm sites totalling **196.1km²** (DEP North, DEP South and SEP) Installation of up to **56 x 14MW wind turbines** and **two OSPs** (one in DEP North and one in SEP if projects are built with a separated grid option) **Offshore cables:** Up to **481km²** of cables comprising: • 2 HVAC export cables up to **102km** in length • Up to **225km** of infield cables	The worst case wind farm site scenario represents a buoyed construction area deployed around the maximum extent of the wind farm site(s) including 500m construction safety zones. The worst case scenario for the cable route is the maximum length of export cable, infield cables and interlink cables and construction buffers allowing for safe passing. **DEP and SEP together worst case scenario per cable**

[2] The individual worst case scenarios presented for export, interlink and infield cables would not represent a developable scenario if taken as a total, therefore a 'realistic' worst case scenario for all cables is presented for this and for all other activities that vary depending on the development scenario in question. This includes sandwave clearance and number of OSP.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	90km; DEP South: 45km) • Up to 3 parallel interlink cables between DEP South and OSP in DEP North: up to **66km** in length (combined) • Burial depth: 0.5 to 1.5m (excluding burial in sand waves up to 20m; export cable surface lay possible in Cromer Shoal Chalk Beds MCZ) and up to 1.0m for the export cables. • Cable trench maximum width of disturbance: 3.0m • Maximum area disturbed: **0.789km²** (Export cable **0.186km²**, Infield cables **0.405km²**,	• Cable trench maximum width of disturbance: Same as DEP in isolation • Maximum area disturbed: **0.390km²** (Export cable 0.12km², Infield cables 0.27km²) **Subsea cable surface protection and pipeline crossings** • Up to **1.5km of surface protection: 7,000m²** (0.5km export cables, 1.0km infield cables) • Up to **4 crossings** (overtrawlable) each with 2,100m² footprint (**8,400m²**)	• Up to 7 interlink cables from DEP North to OSP in SEP, up to **154km** total length • Burial depth: Same as DEP and SEP in isolation • Cable trench maximum width of disturbance: Same as DEP and SEP in isolation **Realistic worst case scenario for all cables** • Up to **448km** of cables based on realistic scenario: **1.35km²** (Export cable 0.24km², Infield cables 0.68km², Interlink cables 0.43km²) **Subsea cable surface protection and pipeline crossings**	**Export:** DEP and SEP are developed with a separated grid option (each having their own substation and export cable). **Infield:** Assumes SEP, DEP North and DEP South are all built. **Interlink:** Assumes DEP and SEP are developed with an integrated grid option but only DEP North is developed. **DEP and SEP together realistic worst case scenario for all cables** The realistic worst case scenario for cables is DEP and SEP are developed with an integrated grid option and both DEP North and DEP South are developed. The worst case for DEP and SEP together considers tandem construction on

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	Interlink cables **0.198km²**) **Subsea cable surface protection and pipeline crossings** • Up to **3.0km of surface protection: 16,000m²** (1.0km export cables, 0.5km interlink cables, 1.5km infield cables) • Up to **17 crossings** (overtrawlable) each with 2,100m² footprint (**35,700m²**) **HDD Exit Point (978m²)** • Initial trench: **600m²** • Transition zone: **50m²** • Jack up footprint: **128m²**	**HDD Exit Point (978m²)** • Initial trench: **600m²** • Transition zone: **50m²** • Jack up footprint: **128m²** • Deposited material on seabed: **200m²** **HDD exit cable protection**	• Up to **4.5km of surface protection: 16,000m²** (0.5km export cables, 1.5km interlink cables, 2.5km infield cables) • Up to **21 crossings** (overtrawlable) each with 2,100m² footprint (**44,100m²**) **HDD Exit Point (1356m²)** • Initial trench: **600m²** • Transition zone: **100m²** • Jack up footprint: **256m²** • Deposited material on seabed: **400m²** **HDD exit cable protection** • 200m of HDD exit point cable protection: **600m²**	account of increased construction activity in the study area at the same time. Construction vessel maximum personnel details will be incorporated post PEIR. Horizontal Directional Drilling (HDD) beneath intertidal zone

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	• Deposited material on seabed: **200m²** **HDD exit cable protection** • 100m of HDD exit point cable protection: **300m²** **Maximum temporal footprint** • Duration of offshore construction: **2 years** **Construction vessels:** • Maximum number of construction vessels on site at any one time: up to **16** vessels • Construction vessel trips to port: **603** over 2 year construction period	• 100m of HDD exit point cable protection: **300m²** **Maximum temporal footprint** • Duration of offshore construction: **2 years** **Construction vessels:** • Maximum number of construction vessels on site at any one time: up to 16 vessels • Construction vessel trips to port: 603 over 2 year construction period	**Maximum temporal footprint** • Duration of offshore construction activities: **4 years** if built sequentially with a maximum gap between offshore construction activities of one year **Vessel movements:** • Maximum number of construction vessels on site at any one time: up to **25** (in total if both DEP and SEP constructed concurrently) • Construction vessel trips to port: **1,196** during 4 year	with offshore exit point approximately 1,000m offshore. For the DEP and SEP together scenario, the initial trench assumes both export cables are within the same initial trench, meaning the area of disturbance is the same as DEP and SEP in isolation scenarios. However, for the transition zone it assumes two trenches therefore the area of disturbance is double DEP and SEP in isolation scenarios. Jack up footprint for DEP and SEP together is includes total jack up legs footprint and jack up movements required.

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
			construction period if constructed sequentially	
Operation				
Collision and allision	**Wind farm sites:** Up to **32 wind turbines** with jacket foundations (maximum structure dimensions at the sea surface) and **one OSP** in DEP North with jacket foundation. Separation distances: 500m from existing operational infrastructure and wind turbines proposed and 990m between DEP turbines. Minimum air gap: 26m **Maximum temporal footprint:** The operational lifetime is expected to be 35 years	**Wind farm sites:** Up to **24 wind turbines** with jacket foundations (maximum structure dimensions at the sea surface) and **one OSP** in SEP with jacket foundation. Separation distances: 500m from existing operational infrastructure and wind turbines proposed and 990m between SEP turbines. Minimum air gap: 26m **Maximum temporal footprint:** The operational lifetime is expected to be 35 years	**Wind farm sites:** Up to **56 wind turbines** with jacket foundations (maximum structure dimensions at the sea surface) and **two OSPs** (one in DEP North and one in SEP if DEP and SEP are built with a separated grid option) with jacket foundations. Separation distances: 500m from existing operational infrastructure and wind turbines proposed and 990m between both DEP and SEP turbines. Minimum air gap: 26m **Maximum temporal footprint:** The operational	Layout worst case places turbines on the periphery. Modelling within the NRA which informs this chapter includes a flood tide dominated scenario which upon analysis gave the worst case modelling results. **Re-routing assumptions:** All alternative routes maintain a minimum mean distance of 1nm from offshore installations and existing wind turbine boundaries in line with the MGN 543 Shipping Route Template (MCA, 2016). This distance is considered for shipping and navigation from a safety perspective. Sandbanks, adverse weather and known routeing

Impact	DEP in Isolation	SEP in Isolation	DEP & SEP Together	Notes and Rationale
	Vessel movements: • Maximum number of vessels on site at any one time: **7** • Operation and maintenance vessel trips to port per year: approximately **690** (although majority (624) will be (small O&M vessel (CTV)) **Cable protection** As construction.	**Vessel movements:** • Maximum number of vessels on site at any one time: **7** • Operation and maintenance vessel trips to port per year: approximately **690** (although majority (624) will be (small O&M vessel (CTV)) **Cable protection** As construction.	lifetime is expected to be 35 years **Vessel movements:** • Maximum number of vessels on site at any one time: **9** (in total if both DEP and SEP constructed concurrently) • Operation and maintenance vessel trips to port per year: approximately **694** (although majority (624) will be (small O&M vessel (CTV)) **Cable protection** As construction.	preferences are also taken into account. Operation and maintenance maximum personnel details will be incorporated post PEIR.
Decommissioning				
Vessel displacement and collision and allision	Decommissioning arrangements will be detailed in a Decommissioning Plan, which will be detailed agreed prior to construction. This plan will include lighting and ensure lighting and marking mitigation remain functioning throughout the life of the project and include where an obstruction is left in place.			Decommissioning areas will be assumed as those defined by the construction phase.

15.3.2.2

15.3.2.3 Construction Scenarios

12. The following principles set out the framework for how DEP and SEP may be constructed:
    - DEP and SEP may be constructed at the same time, or at different times;
    - If built at the same time both projects could be constructed in four years, with offshore construction being undertaken over two years (likely years three and four) of the overall construction period;
    - If built at different times, either project could be built first;
    - If built at different times the first project would require a four-year period of construction including a two year offshore construction period, the second project a three-year period of construction including a two year offshore construction period;
    - If built at different times, the duration of the gap between start of construction of the first project, and the start of construction of the second project may vary from two to four years;
        - If the gap between the projects is less than two years, the first project would wait for the second project in order to be constructed together.
    - Assuming maximum construction periods, and taking the above into account, the maximum period over which the construction of both projects could take place is seven years; and
    - The earliest construction start date is 2024 and the latest is 2028.
13. In order to determine which construction scenario presents the realistic worst case for each receptor and impact, the assessment considers both maximum duration effects and maximum peak effects, in addition to each project being developed in isolation, drawing out any differences between DEP and SEP.
14. The three construction scenarios considered by the shipping and navigation assessment are therefore:
    - Build DEP or build SEP in isolation;
    - Build DEP and SEP concurrently – reflecting the maximum peak effects; and
    - Build DEP and SEP sequentially with a gap of up to four years between the start of construction of each Project – reflecting the maximum duration of effects. This would result in a maximum gap in offshore construction of one year.
15. For shipping and navigation any differences of effect between DEP and SEP construction in isolation are discussed where relevant in the assessment section of this chapter (**Section 15.6**). For each impact in **Section 15.6** the DEP and SEP are also assessed together, with the worst case for shipping and navigation that the projects are built concurrently.

15.3.2.4 Operation Scenarios

16. Operation scenarios are described in detail in **Chapter 5 Project Description**. The assessment considers the following three scenarios:
    - Only DEP in operation;

- Only SEP in operation; and
- DEP and SEP operating at the same time, with a gap of up to three years between each project commencing operation.

17. The operational lifetime of each project is expected to be 35 years.

15.3.2.5 Decommissioning Scenarios

18. Decommissioning scenarios are described in detail in **Chapter 5 Project Description**. Decommissioning arrangements will be agreed through the submission of a Decommissioning Plan prior to construction, however for the purpose of this assessment it is assumed that decommissioning of DEP and SEP could be conducted separately, or at the same time (which represents worst case).

15.3.3 Summary of Mitigation Embedded in the Design

19. The location of the wind farm sites and proposed offshore export cable corridor has been selected to avoid routes and areas of high density shipping as far as possible. This is the key embedded mitigation with regard to shipping and navigation. **Chapter 4 Site Selection and Alternatives** describes the process of development of the wind farm sites and the proposed offshore export cable corridor.

20. Notably through site selection, DEP and SEP avoids IMO routeing measures (closest 30nm away), existing platforms, areas licenced for dredging and aggregate extraction, and MoD practice and exercise areas. Potential interactions with neighbouring infrastructure, navigational features, main routes, pipelines, telecommunication and transmission cables have also been minimised as far as possible given other constraints.

21. In addition to site selection considerations, other embedded mitigation measures which will be in place (as detailed further in the NRA (**Appendix 15.1, Table 20.1**)), consist of:

- Lighting and marking in consultation and agreement with Trinity House, MCA, and the CAA, and considering IALA O-130 (IALA, 2013). This will be secured through the Development Consent Order (DCO) / DML conditions.
- Application for safety zones during construction and periods of major maintenance. Application for safety zones will be made post consent under 'The Electricity (Offshore Generating Stations) (Safety Zones) (Applications Procedures and Control of Access) Regulations 2007 (SI No 2007/1948)'.
- Compliance by all project vessels with International maritime law and flag state regulations, COLREGS (IMO, 1972) and SOLAS (IMO, 1974).
- Operational procedures for project vessels including transit routes to site. This will be secured through the DCO / DML conditions.
- Layout will be discussed and agreed with the MCA and Trinity House. It is noted that the final layout will comply with the layout rules and secured through the DCO / DML conditions.

- Compliance with all aspects of MGN 543 including its annexes. This condition of the DCO / DML includes the completion of checklist (Search and Rescue Checklist) to ensure all elements of MGN 543 have been effectively addressed.
- Marine coordination via a dedicated onshore base from where the project including associated vessel movements will be coordinated and managed. Advance warning and accurate location details of construction, maintenance and decommissioning operations, associated Safety Zones and advisory passing distances will be given via Notices to Mariners and Kingfisher Bulletins and other appropriate media. This will be secured via through the DCO / DML conditions.
- ERCoP to be completed in the required format and structure (MCA, 2019), and to be updated and agreed on a live basis in liaison with the MCA.
- Use of guard vessels identified as necessary via risk assessment, as required under MGN 543. This will be secured through the DCO / DML conditions.
- Display of project infrastructure on appropriately scaled nautical charts, including cables. This will be secured through the DCO / DML conditions.
- Cable Burial Risk Assessment. All subsea cables suitably protected with periodic monitoring of cable burial / protection to ensure it remains effective. A Cable Burial Risk Assessment will be undertaken pre-construction, including consideration of under keel clearance. This will be secured through the DCO / DML conditions.
- Monitoring arrangements to be agreed with the MCA before construction, including marine traffic monitoring during construction and hydrographic surveys (as per MGN 543 (MCA, 2016)).
- Air Clearance. Wind turbines to have at least 26m clearance above Mean High Water Spring (MHWS).
- Stakeholder consultation will continue to be undertaken by Equinor and commercial and technical agreements put in place where required ahead of construction.

15.4 Impact Assessment Methodology

15.4.1 Policy, Legislation and Guidance

15.4.1.1 National Policy Statements

22. The assessment of potential impacts upon shipping and navigation has been made with specific reference to the relevant National Policy Statements (NPS). These are the principal decision making documents for Nationally Significant Infrastructure Projects (NSIPs). The NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011) is the NPS of most relevance to shipping and navigation. The NPS for Ports (Department for Transport, 2012) also provides relevant information.

23. The specific assessment requirements for shipping and navigation, as detailed in the NPS, are summarised in **Table 15.3** together with an indication of the section of the PEIR chapter where each is addressed.

Table 15.3: NPS Assessment Requirements.

NPS Requirement	NPS Reference	Section Reference
EN-3 NPS for Renewable Energy Infrastructure		
There may be constraints imposed on the siting or design of offshore wind farms because of restrictions resulting from the presence of other offshore infrastructure and activities.	Section 2.6, paragraph 2.6.35	**Chapter 4 Site Selection and Alternatives** provides the rationale for the location of the wind farm areas, array cables and proposed offshore export cable corridor, which includes consideration of constraints associated with shipping activities.
Applicants should establish stakeholder engagement with interested parties in the navigation sector early in the development phase of the proposed offshore wind farm and this should continue throughout the life of the development including during the construction, operation and decommissioning phases. Such engagement should be taken to ensure that solutions are sought that allow offshore wind farms and navigation uses of the sea to successfully co-exist.	Section 2.6, paragraph 2.6.153	Consultation with stakeholders including regular operators is being undertaken by Equinor, consultation responses received to date are shown in **Table 15.1**.
Assessment should be underpinned by consultation with the MMO, Maritime and Coastguard Agency (MCA), the relevant General Lighthouse Authority, the relevant industry bodies (both national and local) and any representatives of recreational users of the sea, such as the Royal Yachting Association (RYA), who may be affected.	Section 2.6, paragraph 2.6.154	Consultation with stakeholders including regular operators is being undertaken by Equinor, consultation responses received to date are shown in **Table 15.1**.

NPS Requirement	NPS Reference	Section Reference
Information on internationally recognised sea lanes is publicly available and this should be considered by applicants prior to undertaking assessments. The assessment should include reference to any relevant, publicly available data available on the Maritime Database.	Section 2.6, paragraph 2.6.155	There are no IMO routeing measures in proximity to the wind farm sites or the offshore export cable corridor. The nearest is approximately 30nm north west of the wind farm sites. Main routes are identified in **Section 15.5** and **Appendix 15.1**.
Applicants should undertake a Navigational Risk Assessment (NRA) in accordance with relevant Government guidance prepared in consultation with the MCA and the other navigation stakeholders. The navigation risk assessment will for example necessitate: ● a survey of vessels in the vicinity of the proposed wind farm; ● a full NRA of the likely impact of the wind farm on navigation in the immediate area of the wind farm in accordance with the relevant marine guidance; and ● cumulative and in-combination risks associated with the development and other developments (including other wind farms) in the same area of sea.	Section 2.6, paragraph 2.6.156 and 157	A preliminary NRA is found in **Appendix 15.1** which is fully compliant with relevant guidance and has been developed in consultation with the MCA and other stakeholders.

NPS Requirement	NPS Reference	Section Reference
Where there is a possibility that safety zones will be sought around offshore infrastructure, potential effects should be included in the assessment on navigation and shipping. Where the precise extents of potential safety zones are unknown, a realistic worst case scenario should be assessed. Applicants should consult the MCA and refer to the Government guidance on safety zones.	Section 2.6, paragraph 2.6.158 and 159	Safety zones that are expected to be applied for are detailed in **Chapter 5, Project Description**
The potential effect on recreational craft, such as yachts, should be considered in any assessment.	Section 2.6, paragraph 2.6.160	Assessment on recreational craft located within **Section 15.6**.
NPS for Ports		
Shipping will continue to provide the only effective way to move the vast majority of freight in and out of the UK, and the provision of sufficient sea port capacity will remain an essential element in ensuring sustainable growth in the UK economy.	3.1.4	Nearby ports are identified in **Section 15.5**. **Section 15.6** assesses associated vessel movements.
Demand for port capacity to service manufacture, operation and maintenance of offshore windfarms will be substantial, especially in the short term in support of the 'Round 3' offshore developments. To some extent, capacity provided for by container terminal consents may help to contribute, on an interim basis, to meeting this demand. Because of the Government's renewables targets and in light of the policies set out in the Renewable Energy NPS (EN-3), there is a strong public interest in enabling ports to service these developments.	3.4.10	Nearby ports are identified in **Section 15.5**. **Section 15.6** assesses associated vessel movements. **Chapter 29 Socioeconomics and Tourism** considers socio economic effects on ports.

15.4.1.2 Other

24. In addition to those above, there are a number of pieces of guidance applicable to the shipping and navigation assessment. These include:

- MGN 543[3] (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on United Kingdom (UK) Navigational Practice, Safety and Emergency Response (MCA, 2016);
- MGN 372[2] (Merchant and Fishing) OREIs: Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA, 2008);
- Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI) (MCA, 2013);
- Revised Guidelines for FSA for use in the Rule-Making Process (International Maritime Organization (IMO), 2018);
- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, 2013);
- The Royal Yachting Association's (RYA's) Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy (RYA, 2019); and
- Standard Marking Schedule for Offshore Installations (DECC, 2011a).

25. Further detail is provided in **Chapter 3 Policy and Legislative Context**.

15.4.2 Data and Information Sources

26. Data sources used to inform the assessment are listed in **Table 15.4** and reflect those gathered and analysed as part of the NRA (**Appendix 15.1**).

Table 15.4: Available data and information sources.

Data set	Spatial coverage	Year	Notes
Vessel Traffic Survey	Study Area	2020	14 days of AIS, radar, and visual observation data collected during July and August of 2020
	Study Area	2021	14 days of AIS, radar and visual observation data collected during a winter period (Jan-Feb 2021) and analysed post PEIR
Vessel Traffic (AIS data)	Study Area	2019	12 months of AIS data covering the entirety of 2019

[3] It is noted that revised MGN documents which will replace 543 and 372 are expected in early 2021 and any changes will be incorporated post PEIR

Data set	Spatial coverage	Year	Notes
	Study Area	2020	14 days of AIS, radar, and visual observation data collected during July /August 2020
Maritime incidents	Study Area	2008-2017	Maritime Accident Investigation Branch (MAIB) marine accidents database
	Study Area	2008 – 2017	Royal National Lifeboat Institution (RNLI) incident data
	Study Area	2016-2018	Department for Transport (DfT) UK civilian SAR helicopter taskings
Marine Aggregate Dredging Features	Study Area	Crown Estate, Cefas and MMO layers. Downloaded 2020.	Marine aggregate dredging areas (licenced and active)
	Study Area	Published 2009 (downloaded 2020)	Transit routes, British Marine Aggregate Producers Association (BMAPA)
Recreational vessel traffic and facilities	Study Area	2018 (downloaded 2020)	RYA Coastal Atlas (RYA, 2018)
Other Navigational Features	Study Area	2020	United Kingdom Hydrographic Office (UKHO) Admiralty Charts
Weather Data	Study Area	2019	DEP & SEP, UK Metocean Summary, Doc Ref: MAD, CDEZ 11.10.2019, Metocean ME2019–144 (Equinor 2019)

Data set	Spatial coverage	Year	Notes
	Study Area	2016	Admiralty Sailing Directions NP54 North Sea West
	Study Area	2020	UKHO Admiralty Charts, tidal flow data

15.4.3 Impact Assessment Methodology

27. **Chapter 6 EIA Methodology** provides a summary of the general impact assessment methodology applied to DEP and SEP. The following sections confirm the methodology used to assess the potential impacts on shipping and navigation.

28. The assessment of impacts to shipping and navigation has focused on establishing potential for overlaps, interactions and the potential for conflict between activities and through consultation with the relevant stakeholders as discussed in **Section 15.2**.

15.4.3.1 Definitions

29. For each effect, the assessment identifies receptors that are exposed to that effect and implements a systematic approach to understanding the impact pathways and the level of impacts on given receptors. The definitions, frequency and severity of consequence (broadly similar to sensitivity and magnitude as described in **Chapter 6**), for the purpose of the shipping navigation assessment are provided in **Table 15.5** and **Table 15.6**, and align with the FSA.

Table *15.5 Definition of frequency of occurrence on shipping and navigation receptor*

Frequency (& ranking)	Definition
Frequent (5)	Yearly
Reasonably probable (4)	1 per 1–10 years
Remote (3)	1 per 10–100 years
Extremely unlikely (2)	1 per 100–10,000 years
Negligible (1)	< 1 occurrence per 10,000 years

Table 15.6 Definition of severity of consequence on shipping and navigation receptor

Severity of Consequence (& ranking)	Definition			
	People	Property	Environment	Business
Major (5)	More than one fatality.	Total loss of property.	Tier 3 national assistance required.	International reputational impacts.
Serious (4)	Multiple serious injury or single fatality.	Damage resulting in critical impact on operations.	Tier 2 regional assistance required.	National reputation impacts.
Moderate (3)	Multiple minor or single serious injury.	Damage not critical to operations.	Tier 2 limited external assistance required.	Local reputation impacts.
Minor (2)	Slight injury(s).	Minor damage to property i.e., superficial damage.	Tier 1 local assistance required.	Minor reputational impact – limited to users.
Negligible (1)	No perceptible impact.	No perceptible impact.	No perceptible impact.	No perceptible impact.

15.4.3.2 Impact Significance

30. In basic terms, the potential significance of an impact is a function of the sensitivity of the receptor and the magnitude of the effect (see **Chapter 6 EIA Methodology** for further details). For the shipping and navigation assessment, the terms frequency and severity consequence (which are used within the FSA) are used in a comparable way. The determination of significance is guided by the use of an matrix (as used in the FSA), as shown in **Table 15.7**. Definitions of each level of significance in EIA terms are provided in **Table 15.8**.

31. Potential impacts identified within the assessment as major or moderate are regarded as significant in terms of the EIA regulations. Appropriate mitigation has been identified, where possible, in consultation with the regulatory authorities and relevant stakeholders. The aim of mitigation measures is to avoid or reduce the overall impact in order to determine a residual impact upon a given receptor.

Table 15.7 Impact matrix

		Severity of Consequence				
		Major	**Serious**	**Moderate**	**Major**	**Negligible**
Frequency	**Frequent**	Unacceptable (high risk)	Unacceptable (high risk)	Unacceptable (high risk)	Tolerable (intermediate risk)	Tolerable (intermediate risk)
	Reasonably probable	Unacceptable (high risk)	Unacceptable (high risk)	Tolerable (intermediate risk)	Tolerable (intermediate risk)	broadly acceptable (low risk)
	Remote	Unacceptable (high risk)	Tolerable (intermediate risk)	Tolerable (intermediate risk)	broadly acceptable (low risk)	broadly acceptable (low risk)
	Extremely unlikely	Tolerable (intermediate risk)	Tolerable (intermediate risk)	broadly acceptable (low risk)	broadly acceptable (low risk)	broadly acceptable (low risk)
	Negligible	Tolerable (intermediate risk)	Tolerable (intermediate risk)	broadly acceptable (low risk)	broadly acceptable (low risk)	broadly acceptable (low risk)

Table 15.8 Definition of impact significance

Significance	EIA Definition	FSA Definition
Major	Impact is Significant (Major).	Safety risks are unacceptable (high risk) and not considered As Low as Reasonably Practicable (ALARP).

Significance	EIA Definition	FSA Definition
Moderate	Impact is Significant (Moderate).	Safety risks is tolerable (intermediate risk) and ALARP if appropriate mitigation is put in place to control or monitor risk.
Minor	Impact is not Significant (Minor).	Safety risks are broadly acceptable (low risk) and ALARP, mitigation may be recommended.
Negligible	Impact is not Significant (Negligible).	No discernible change in receptor condition. Safety risks are acceptable and ALARP without additional mitigation.

15.4.4 Cumulative Impact Assessment Methodology

32. Projects and plans within 100nm of DEP and SEP have been screened and characterised (based on proximity and effect on routeing) as part of the NRA process (**Appendix 15.1**) so that developments which may increase the effect of impacts to shipping and navigation receptors when considered alongside the Project have been considered as appropriate. Further detail on potential cumulative impacts is also provided in **Section 15.7**.

15.4.5 Transboundary Impact Assessment Methodology

33. The transboundary assessment considers the potential for transboundary effects to occur on shipping and navigation as a result of DEP and SEP; either those that might arise within the Exclusive Economic Zone (EEZ) of European Economic Area (EEA) states or arising on the interests of EEA states e.g. a non UK fishing vessel. **Chapter 6 EIA Methodology** provides further details of the general framework and approach to the assessment of transboundary effects.

34. For shipping and navigation, the potential for transboundary effects has been scoped in given that the main destinations of cargo vessels include European ports.

15.4.6 Assumptions and Limitations

35. To date, radar and visual observation data has only been collected for a 14 day summer survey period for the shipping and navigation study area. This means that non-AIS traffic is likely to be underrepresented within the 14 day winter data set, and within the 28 days of data assessed for the offshore export cable corridor. It is noted that the approach to marine traffic data has been agreed with the MCA, Trinity House, RYA, CA, and the CoS as per **Section 15.2**, and this includes a second 14 day survey undertaken in Jan-Feb 2021 to obtain winter data (also see **Table 15.4**).

15.5 Existing Environment

36. The full baseline characterisation is provided in the NRA (**Appendix 15.1**) and summarised here.

15.5.1 Navigational Features

15.5.1.1 Offshore wind infrastructure

37. There are three operational offshore wind farms (OWF)s within the study area: the parent Dudgeon and Sheringham Shoal OWFs; and Race Bank. Triton Knoll OWF, which is under construction, is also within the study area.

15.5.1.2 Oil and gas infrastructure

38. Six gas platforms (three operational and three undergoing decommissioning) are located within the study area, with the Perenco-operated Waveney gas platform the closest, being approximately 0.55km from the northern boundary of the DEP North wind farm site. It is also understood that the Blythe platform (operator: Independent Oil and Gas) will be established in 2021. There are no active wells located within the DEP and SEP wind farm sites but a number of wells and pipelines are located within the study area. Further details regarding oil and gas infrastructure are given in **Chapter 18 Petroleum Industry and Other Marine Users**.

15.5.1.3 Aids to Navigation (AtoN)

39. AtoN within the study area are primarily associated with the peripheral turbine lighting at the operational winds farms as well as those that mark the shallow banks. There are also cardinal buoys marking Triton Knoll OWF in construction.

15.5.1.4 Submarine cables

40. There are 12 submarine cables within the study area. The other charted cables within the shipping and navigation study area are all disused.

15.5.1.5 Marine Aggregate Dredging and Disposal Grounds

41. The nearest licenced areas for aggregate production are the Outer Dowsing areas (515/1 and 515/2), licenced to Westminster Gravels Ltd and located to the north and west of DEP and SEP.

42. There is a closed disposal site (HU147) within the Dudgeon OWF boundary as well as the closed Dudgeon disposal site (HU145) to the north west of the study area. To the east of the study areas is a disposal site associated with the Race Bank OWF export cable corridor (HU126).

43. BMAPA transit routes are found within the study area. AIS analysis over 2019 (**Section 15.4.2**) shows six marine aggregate dredger transits were recorded to intersect the wind farm sites, including transit to the Outer Dowsing aggregate dredging areas, but with the majority passing outside of the DEP and SEP boundaries.

15.5.1.6 Wrecks

44. A total of 172 charted wrecks are located within the study area, with nine of these located within the SEP wind farm site and three within the DEP wind farm sites. See **Chapter 16 Offshore Archaeology and Cultural Heritage** for further details.

15.5.1.7 Navigational Control Measures

45. There are no IMO routeing measures in proximity to the DEP or SEP wind farm sites or the offshore cable corridors. The nearest are those associated with the Humber (the Rosse Reach and Sea Reach Traffic Separation Scheme (TSS) lanes), which are located approximately 30nm north west of the wind farm sites.

46. There are no Marine Environmental High Risk Areas (MEHRA) within the study area.

15.5.1.8 Ports

47. Cromer is within the study area, with a number of other ports along the coast but outside of the study area, including Blakeney Harbour Boston, Great Yarmouth, Grimsby and Immingham, King's Lynn and Sutton Bridge. Of these, Grimsby and Immingham port are the busiest based on vessel arrival data.

15.5.1.9 Anchorages

48. There is one charted anchorage within the study area found south of SEP wind farm site offshore of Cromer. Vessel anchor activity is discussed further in **Section 15.5.4**

15.5.1.10 Military Practice Exercise Areas

49. There are no PEXAs in the study area. Military vessel activity is discussed in **Section 15.5.4** .

15.5.2 Meteorological and Oceanographic Data

50. Wind, wave, tidal and visibility data (**Section 14.4.2**) have been analysed within the NRA (**Appendix 15.1**), given the use of this data within collision and allision risk modelling, and is further detailed in **Chapter 8 Marine Geology, Oceanography and Physical Processes**.

15.5.3 Maritime Incidents

51. Maritime Incident Investigation Branch (MAIB) data (**Section 15.4.2**) has been reviewed within the NRA (**Appendix 15.1**) to establish the incident history within the study area. There are a number of incidents recorded, largely attributed to 'mechanical failure', 'hazardous incident' or 'accident to person' classifications. Of note is that one collision was recorded over the 10 years of data within the study area, specifically in the area between the SEP and DEP wind farm sites, between a passenger vessel and commercial workboat.

52. RNLI responses were predominately coastal in the data (**Section 15.4.2**) analysed within the NRA (**Appendix 15.1**) and largely attributed to machinery failure and person in danger. In terms of emergency response coordination, the following are relevant to DEP and SEP:

- Search And Rescue (SAR) – Given the UK base locations, Humberside is the most likely to respond to any incident requiring SAR helicopter services.
- Royal National Lifeboat Institute (RNLI) – The RNLI have a 100nm operational limit and a number of stations associated with the 'East' division could respond to an incident within the study area.

- Her Majesty's Coastguard (HMCG) – East of England Region encompasses the study area with the closest Coastguard Operation Centres (CGOC) is in Bridlington, in East Yorkshire.
- Assistance from offshore operators – All vessels under IMO obligations, set out in the International Convention for the Safety of Life at Sea (SOLAS) (IMO, 1974) as amended, are required to render assistance to any person or vessel in distress if safely able to do so.

15.5.4 Vessel Movements

15.5.4.1 Traffic Counts

53. Three primary traffic data sets (two 14 day surveys (noting the second 14 day survey will be completed and analysed in 2021 for inclusion in the ES) and long term (12 months) AIS analysis, **Section 15.4.2**) alongside consultation responses have been analysed to establish a comprehensive understanding of exiting vessel movements within the study area as part of the NRA (and to inform the EIA). The data approach has been agreed with the MCA and Trinity House through consultation (**Section 15.2**). Full details are provided in the NRA with supporting figures (**Appendix 15.1**) and summarised here. As the study area (10nm buffer around the wind farm sites) encompasses the 2nm buffer around the cable routes and there is little differentiation between vessel movements within the two buffers, the cable route study area is not described separately.

15.5.4.2 Survey data

54. Survey data shows that the main vessel types within the study area were cargo, tankers, oil and gas support vessels and wind farm support vessels. Aggregate dredgers, passenger, fishing and recreational vessels were also recorded.
55. The regular cargo vessels operating within the study area included Roll On Roll Off vessels operated by Cobelfret Ferries, DFDS Seaways, P&O Ferries and Stena Line. Main destinations included Humber-based ports such as Immingham (UK) and Hull (UK), and European ports such as Rotterdam (Netherlands) and Zeebrugge (Belgium).
56. The main destinations recorded for tankers within the study area were the Humber and mainland Europe. Smaller tankers (and cargo vessels) typically used inshore routes, south of Sheringham Shoal, while the larger tankers (and cargo vessels) transited further offshore between the DEP and SEP wind farm sites.
57. Oil and gas traffic were largely in the eastern half of the study area, intersecting or within close proximity to the DEP wind farm sites. Traffic was typically associated with the Waveney, West Sole or Pickerill gas and Hewett fields.
58. Wind farm support vessels within the study area were typically operating at the Dudgeon, Sheringham Shoal, and Race Bank OWFs.
59. Fishing vessels were recorded on passage through the study area; and also actively engaged in fishing, particularly inshore off Cromer and to the north of the SEP wind farm site.
60. Recreational vessels were predominantly seen transiting along the coast inshore of the SEP wind farm site in the summer months.

61. Aggregate dredgers within the study area were observed to align with the corresponding BMAPA routes. The majority passing south of the SEP wind farm site, and a small proportion of dredgers were recorded in the SEP area and more notably DEP wind farm sites.

15.5.4.3 Long term AIS analysis

62. Long term AIS data (2019 data) has been analysed to validate survey data and to identify any seasonal variation not reflected within the short term (14 day) survey data, and to identify and account for any potential effect the COVID-19 pandemic may have had on shipping activity recorded by the survey. Analysis within the NRA showed annual AIS data in the study area to have comparable trends to the survey data results in terms of vessel type and numbers as well as routeing. A difference was observed for fishing and recreational vessels but this is likely due to the time periods that both datasets were using and it is assumed these average values will be lower once the winter data set, which will be presented post PEIR, is included in the analysis.

63. The main types of vessels detected within the DEP shipping and navigation study area during 2019 were cargo vessels (42%), tankers (22%), and oil and gas vessels (16%). Similarly, the main types of vessels detected during the 2020 summer survey within the DEP wind farm site were cargo vessels (39%), tankers (20%), and oil and gas vessels (15%). Smaller but significant numbers of passenger vessels were also detected during both periods.

64. The main types of vessels detected within the SEP shipping and navigation study area during 2019 were cargo vessels (53%), tankers (18%), and oil and gas vessels (6%). The main types of vessels detected during the 2020 summer survey within the SEP wind farm site were cargo vessels (48%), tankers (15%), wind farm vessels (13%), and oil and gas vessels (7%).

15.5.4.4 Routeing

*Survey data, AIS data (2019), as well as operator timetables, highlight 14 existing main routes (as defined in MGN 543 (MCA, 2016)) within the study area as shown in **Plate 15-1** and **Table 15.9**.*

65. Table 15.9 Of the 14 routes 4 intersect the DEP wind farm site and 10 the cable corridor. No routes overlap the SEP wind farm site boundary, however there is overlap with two routes when considering the corresponding 90th percentile of traffic.

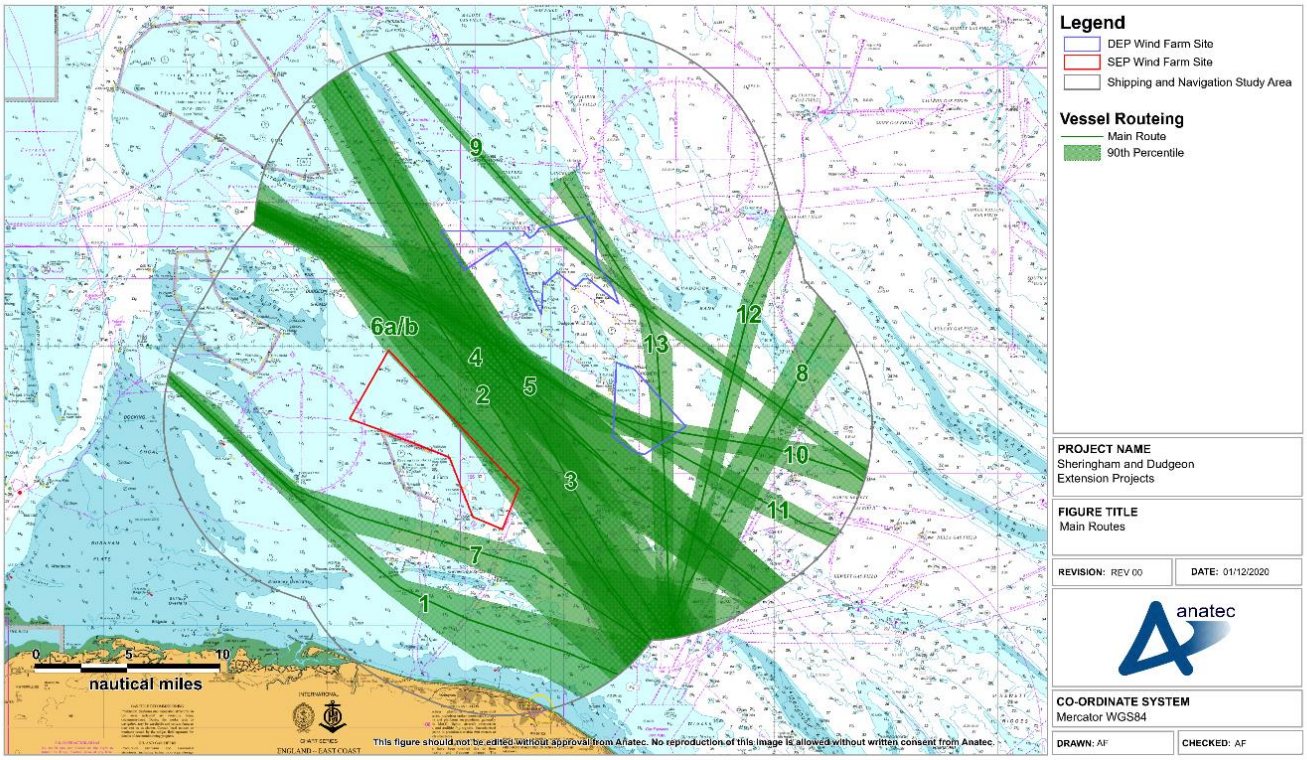

Plate 15-1: Main Routes within the Study Area

Table 15.9 Main Routes within the Study Area

Route	Terminus Ports	Vessels Per Day	Intersection		
			DEP wind farm site	SEP wind farm site	Cable route
1	Humber (UK) / Rotterdam (Netherlands)	20	No	No	Yes
2	Humber (UK) / Rotterdam (Netherlands)	13	No	No	Yes
3	Tees (UK) / Zeebrugge (Belgium)	12	No	No	Yes
4	Humber (UK) / Rotterdam (Netherlands)	12	No	No	Yes
5	Tees (UK) / Rotterdam (Netherlands)	4	No	No	Yes
6a	Hull (UK) / Zeebrugge (Belgium)	2	No	No	Yes
6b	Hull (UK) / Rotterdam (Netherlands)	2	No	No	Yes

Route	Terminus Ports	Vessels Per Day	Intersection		
			DEP wind farm site	SEP wind farm site	Cable route
7	Humber (UK) / Rotterdam (Netherlands)	3	No	No	Yes
8	Great Yarmouth (UK) / Lincolnshire Offshore Gas Gathering System (LOGGS) (UK waters)	2	No	No	Yes
9	Tees (UK) / Rotterdam (Netherlands)	1	Yes	No	No
10	Humber (UK) / Rotterdam (Netherlands)	< 1	Yes	No	No
11	Humber (UK) / Rotterdam (Netherlands)	< 1	Yes	No	No
12	Great Yarmouth (UK) / Clipper (UK waters)	< 1	No	No	Yes
13	Great Yarmouth (UK) / Lancelot (UK waters)	< 1	Yes	No	No

66. Adverse weather (wind, wave, and tidal conditions as well as reduced visibility due to fog) can hinder a vessel's standard route. AIS data, as well as consultation responses highlight that the DFDS Newcastle / Amsterdam route, which is not within the study area, may utilise the "Beach Route" during periods of adverse weather, and that this route is located within the study area, transiting between the Sheringham Shoal and Dudgeon OWFs.

15.5.5 Future Trends

67. The deployment of offshore wind in the UK is set to continue and there is an existing pipeline of projects in planning and further expansion expected with a target of 40GW offshore wind farm capacity by 2030. Offshore wind deployment in the southern North Sea and wider North Sea is likely to increase over the next 10 to 20 years.

68. Traffic trends are difficult to predict but the following potential increases are considered representative of future trends over the lifespan of DEP and SEP:

- 10-20% increase in commercial traffic
- 10% increase in commercial fishing vessel transit
- 10% increase in recreational activity

15.6 Potential Impacts

69. This section uses the navigational safety assessments within the NRA and outcomes of the FSA found within **Appendix 15.1**. The FSA is closely linked to the significance of impacts in EIA terms which are detailed below for each shipping and navigation receptor. The FSA results are presented alongside the EIA significance assessment.

70. The impacts to be assessed have been identified via the Scoping Report and Scoping Opinion (**Section 15.2**).

71. Impacts to communications including (VHF, AIS, GPS, Navigational Telex and radar) from interference (including that from noise and electromagnetic effects) are not assessed, following detailed analysis within the NRA (**Appendix 15.1**) which has highlighted that there are no anticipated effects during the lifecycle of DEP and SEP, both in isolation and together as well as considering other plans and projects.

15.6.1 Potential Impacts during Construction

15.6.1.1 Impact 1: Displacement of Activities

15.6.1.1.1 DEP or SEP in Isolation

72. Existing traffic within the study area, as identified in **Section 15.5.4**, could be displaced during construction (up to 4 years for DEP and SEP together) due to the presence of buoyed construction areas (including 500m rolling active safety zones around fixed structures where work is being undertaken), construction vessels and partially completed or pre-commissioned structures. While construction areas will be defined post consent it is assumed that the construction area could extend 500m beyond the DEP and SEP wind farm site boundaries.

73. Installation of cables may also temporarily displace traffic. However, given that operations will be effectively communicated, managed with minimum safe passing distances (likely 1,000m), and will be both temporary and small in scale, there are not expected to be any identifiable impacts in terms of navigational safety of displacement. As such the assessment below focuses on construction within the DEP and SEP wind farm site boundaries.

74. In order to manage displacement impacts, Equinor will communicate information to ensure third party vessels are aware of construction activities and display information on charts (considered embedded mitigation). Further, vessel traffic will be monitored throughout the construction period, with a yearly report to provide a means of ensuring mitigation is effective. An AtoN Management Plan covering the construction period will also be agreed.

75. DEP and SEP are largely outside the highest density traffic areas within the study area (**Plate 15-2**), however vessels, including commercial (passenger, cargo and tanker), oil and gas, wind farm, aggregate dredger, fishing, and recreation are recorded within the DEP and SEP wind farm boundaries and could be displaced by construction activities.

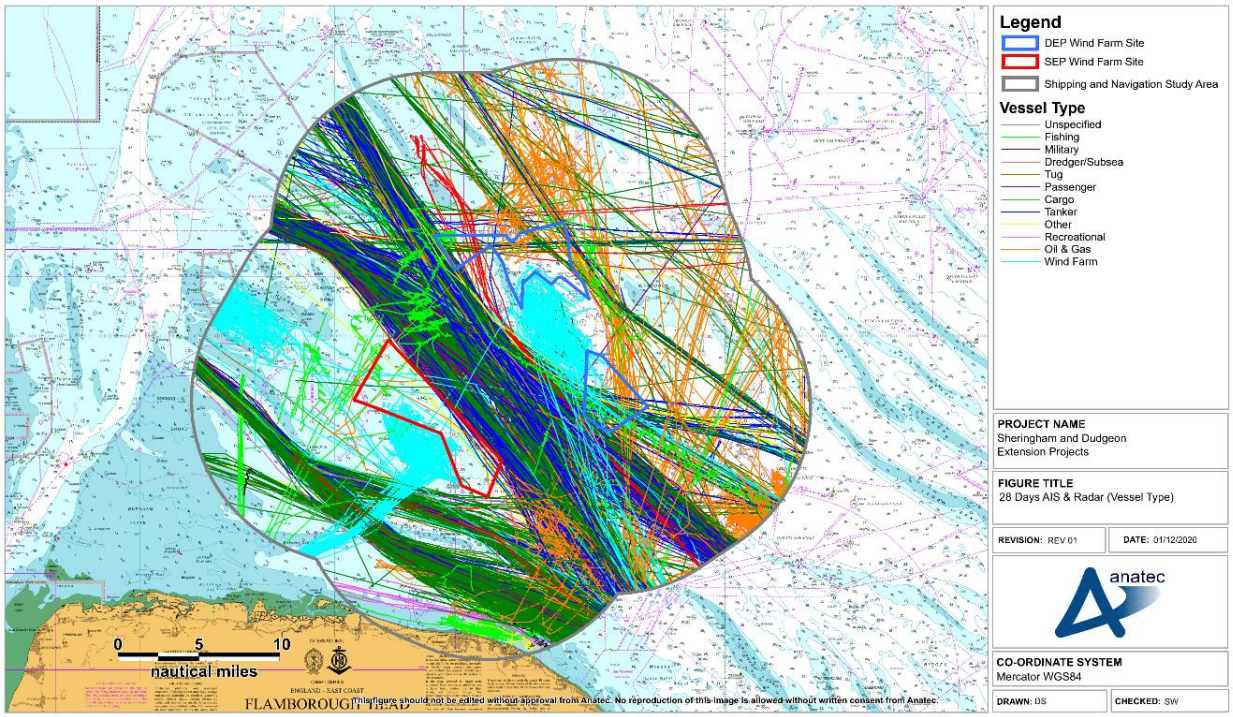

Plate 15-2: Vessel traffic survey data

76. Outside of safety zones vessels are able to access construction areas, however experience from existing OWF projects highlights that commercial vessels would avoid construction areas, whereas smaller and recreation vessels may enter construction areas. Effects for each receptor (main vessel types identified in **Section 15.5**) are outlined in the following sections (with differentiation between the DEP and SEP highlighted where differences are identified). Impacts associated with adverse weather routing are assessed in operational effects, **Section 15.6.2**.

Commercial Vessels

77. Commercial vessels (including cargo, tanker and passenger) are of the vessel type found most frequently within the study area and most likely to avoid construction areas. There are however limited commercial vessels within the SEP wind farm site boundary that would be particularly exposed to any displacement effects, with vessels largely passing between the SEP and DEP wind farm site boundaries outwith a 500m buffer. More notable are interactions with the DEP wind farm site boundaries, with some cargo vessel intersecting DEP South in a northwest to southeast direction, and DEP North in a west to east direction, and intersecting the north east of the site.

78. Given the flexible access to the DEP and SEP wind farm sites throughout construction, main route deviations and adverse weather displacement are only considered as impacts of the operation and maintenance phase in **Section 15.6.2**.

Oil and Gas Vessels

79. Oil and gas vessels are exposed to displacement effects less at SEP given the low counts of vessels recorded inside the wind farm boundary or that pass close to it. For DEP, construction in the DEP South wind farm site would cause displacement to oil and gas vessels in transit as well as those that may access the Blythe platform. In the DEP North wind farm site displacement effects would be to oil and gas vessels in transit as well as those associated with the Waveney platform. The location of the Waveney platform close to the northern boundary of DEP North may cause restricted access to the platform during DEP construction. Similarly, construction may cause the restricted access to the planned Blythe platform and associated subsea infrastructure (including the Elgood subsea well and pipeline tie-back). Impacts to oil and gas operations are further assessed in **Chapter 18 Petroleum Industry and Other Marine Users**, noting a detailed assessment of both marine and airborne access to oil and gas platforms is underway and will be included in the ES.

Wind Farm Support Vessels

80. Wind farm support vessels in the study area are predominately those supporting the parent Dudgeon and Sheringham Shoal OWFs which are mainly located within the operational boundary of the existing sites. There are also wind farm support vessels in transit within the study area, e.g. transiting to Race Bank OWF. Some displacement of vessels during construction is expected, however there will be close cooperation and coordination between the parent sites and DEP and SEP, although the detailed strategy is not compiled at this stage.

Marine Aggregate Dredger Vessels

81. Aggregate dredgers in transit intersect the DEP wind farm site boundaries and to a lesser extent the SEP wind farm site boundary, including vessels transiting to the Outer Dousing aggregate areas. Vessels would be expected to be exposed to some displacement, however the majority of dredger vessels pass outside of the DEP and SEP wind farm site boundaries and would not be exposed to displacement effects.

Fishing Vessels

82. Fishing vessels within the study area would be displaced by construction activities, however fishing vessels are active in the DEP and SEP wind farm sites in low numbers, with limited use of the wind farm site boundaries for active fishing. It is noted that vessels undertaking active fishing would be exposed to displacement effects over a longer time period than those in transit.

83. Displacement to fishing activity and the associated economic effects are further considered in **Chapter 14 Commercial Fisheries**.

Recreational Vessels

84. Recreational vessels make up a small proportion of overall vessel activity within the study area and are predominantly inshore of both the DEP and SEP wind farm site boundaries. Displacement would occur within the DEP and SEP wind farm site boundaries, although there is low usage of these areas by recreational vessels, and while vessels are associated with the coast in higher numbers, cable laying in these areas will be short term and communicated effectively to reduce disturbance.

Overall assessment

85. Displacement will occur daily, thus at a frequent frequency for all receptors during construction. The severity of consequence is negligible given the level of disturbance and deviations required as well as mitigation in place to manage and communicate construction activities. The overall displacement assessment in FSA terms (**Appendix 15.1**) is *tolerable with additional mitigation, and ALARP*. The impact of displacement is therefore of **moderate adverse** significance in EIA terms for both DEP and SEP in isolation.

15.6.1.1.2 DEP and SEP Together

86. Should DEP and SEP be constructed concurrently, there would be an increase in construction vessels and disturbance, however there would be no overlap in construction areas and construction areas would be rolling, coordinated and allow flexible access and the severity of consequence would not measurably increase. Thus potential displacement impacts of DEP and SEP together would be the same (**moderate adverse**) as in isolation (**Section 15.6.1.1.1**). Impacts associated with reduced sea room between the DEP and SEP boundary are assessed as operational effects, **Section 15.6.2**.

15.6.1.2 Impact 2: Increased Collision Risk

15.6.1.2.1 DEP or SEP in Isolation

87. Vessel to vessel (third party), and construction vessel to third party collision risk may be increased by the physical presence of precommissioned structures and associated works via the displacement of existing vessel activity and increased vessel numbers associated with construction activities within the study area.

88. Within the study area the highest existing encounter rates are found between the parent Dudgeon and Sheringham Shoal offshore wind farms, with large volumes of traffic utilising similar passage. Encounters are lowest within the DEP and SEP wind farm site boundaries and flexible access to the wind farms sites will be maintained throughout construction. Given this, and the mitigation that will be in place during construction, collision risk is typically lower during construction than operation and as such collision risk modelling is only considered within the assessment for operational effects (**Section 15.6.2**), with a qualitative assessment made during construction. However it is noted that at its peak the construction phase collision risk will become that of the operational phase as the last of the relevant project infrastructure is installed.

89. In order to manage collision risk Equinor will coordination and communicate information to ensure third party vessels are aware of construction activities and display information on charts. Vessels will also adhere to COLREGS (IMO, 1972) and SOLAS (1974). Further, vessel traffic and encounters will be monitored throughout the construction period, with a yearly report to provide means of ensuring mitigation is effective. An AtoN Management Plan will also be agreed covering the construction period.

90. Within the study area there is existing operational traffic transiting to the parent Dudgeon and Sheringham Shoal wind farm sites, and as such vessels will largely be familiar with wind farm traffic in the area, noting that similar transit routes to DEP and SEP wind farm sites by project vessels are likely. Moreover, there has not been any recorded incident within a buoyed construction area of a UK wind farm whereby a third party vessel has collided with a construction vessel.

91. Given the level of displacement as well as existing encounter and collision rates adjacent to and between DEP and SEP wind farm boundaries, a remote frequency is assigned. The embedded mitigation is tried and tested within the industry, and given the incident history within offshore wind farm construction areas, a serious consequence is assigned.

92. In FSA terms the increase in collision risk for DEP and SEP in isolation (covering the entire project lifecycle) between third party vessels is assessed as being *tolerable with additional mitigation* and *ALARP* and *broadly acceptable and ALARP* for third party to project vessels, resulting in a **moderate adverse** significance in EIA terms for both DEP and SEP in isolation.

15.6.1.2.2 DEP and SEP Together

93. In FSA terms collision risk for DEP and SEP together (covering the entire project lifecycle) between third party vessels is assessed as being *tolerable with additional mitigation* and *ALARP and broadly acceptable and ALARP* for third party to project vessels.

94. Should DEP and SEP be constructed concurrently, the potential collision impacts would be the same (**moderate adverse** in EIA terms) as if they were to be constructed in isolation (**Section 15.6.1.1.1**). This is because there would be no overlap in construction areas and construction areas would be rolling, coordinated and allow flexible access and the severity of consequence would not measurably increase. Impacts associated with reduced sea room between the DEP and SEP boundary are assessed within operational effects, **Section 15.6.2**.

15.6.1.3 Impact 3: Increased Allision Risk

15.6.1.3.1 DEP or SEP in Isolation

95. The physical presence of pre-commissioned structures would create a vessel to structure allision risk (both vessels under power and drifting) for a vessel navigating within the study area. As per collision risk, allision is likely to be less during construction than operation up to the point of the final infrastructure installation and the modelling undertaken to support the FSA is considered within operational impacts (**Section 15.6.2**).

96. Commercial vessels (cargo, tanker and passenger) as well as dredgers, which account for the majority of vessels recorded in the study area, would likely avoid the buoyed construction area and not be exposed to allision risks. Other vessels types are discussed below.

97. Wind farm vessels in particular are likely to have crew who are experienced in safely transiting OWF construction areas, and those associated with the operational Dudgeon and Sheringham Shoal wind farm will also be experienced in working in the local maritime environment.

98. Oil and gas support vessels associated with the Waveney platform spend longer in the DEP North boundary than other vessels in transit and may experience increased allision risk, given access requirements to the platform. Allision risk to vessels in transit is within the scope of the NRA, whereas vessels associated with servicing the platforms upon arrival is not. Thus, the details of the rolling construction plan will be used alongside further consultation with the operators, Perenco, to identify any specific mitigation required in relation to DEP impacts on oil and gas vessels and access arrangements at Waveney. This also applies to the Blythe platform (Independent Oil and Gas) where construction near the DEP South boundary may impact access. Impacts to oil and gas operations are further assessed in **Chapter 18 Petroleum Industry and Other Marine Users** , noting a detailed assessment of both marine and airborne access to oil and gas platforms is underway and will be included in the ES.

99. Fishing vessels engaged in fishing are at increased risk given the increased time spent in proximity to structures, compared to passing vessels, however as described in **Section 15.5**, fishing activity is low within the SEP and DEP wind farm site boundaries where allision risk would occur.

100. Recreation vessels are present in very low numbers within the DEP and SEP wind farm boundaries where allision risk would occur, with any vessels also likely to be traveling at low speeds which would reduce the severity of consequence.

101. Allision incidents between a vessel and a wind turbine (under construction, operational or disused) in the UK are low with an average of 1 per 1,620 years including both operational and non-operational turbines.

102. Given the vessel traffic within the SEP and DEP wind farm boundaries, the likelihood of interaction, incident history, and the embedded mitigation the frequency is remote and the severity of consequence is serious. In FSA terms allision risk for DEP and SEP together (covering the entire project lifecycle) is assessed as being *tolerable with embedded mitigation* and *ALARP.* This results in a potential impact of **moderate adverse** significance in EIA terms.

15.6.1.3.2 DEP and SEP Together

103. In FSA terms the risk over the project lifetime is assessed as being *tolerable with embedded mitigation, and ALARP.* Should DEP and SEP be constructed concurrently, the potential allision impacts would be the same (**moderate adverse**) as in isolation. This is because there would be no overlap in construction areas and the severity of consequence would not measurably increase. Impacts associated with reduced sea room between the DEP and SEP boundaries is assessed within operational effects, **Section 15.6.2**.

15.6.1.4 Impact 4: Interaction with Partially Completed Subsea Cables

15.6.1.4.1 DEP or SEP in Isolation

104. Scenarios that could lead to cable interaction during construction include:

- Vessel dragging an anchor over partially completed cable following anchor failure; and

- Vessel anchoring in an emergency, inadvertently (e.g. mechanical failure) or negligently over a partially completed cable.

105. Interaction could occur with vessels within the DEP and SEP offshore cable route study area (**Section 15.3.1**). Vessel count observations, during the 28 day survey (**Section 15.4.2**) showed the majority of anchored vessels were oil and gas support vessels and cargo vessels located near the Weybourne landfall. An average of approximately one unique vessel every two days was determined to be at anchor during the survey period within the offshore export cable corridor shipping and navigation study area. The closest anchored vessel to the export cable corridor was an oil and gas vessel situated approximately 0.36nm from the export cable corridor.

106. Given the vessel traffic and baseline anchoring activity within the DEP and SEP export cable study area and the likelihood of interaction, as well as embedded mitigation such as safe passing distances, the impact frequency is extremely unlikely and the severity of consequence is moderate. In FSA terms the likely navigation safety risk of cable interaction is assessed as being *broadly acceptable with embedded mitigation, and ALARP*. The impact is thus of **minor adverse** significance in EIA terms for both DEP and SEP insolation.

15.6.1.4.2 DEP and SEP Together

107. In FSA terms the likely navigation safety risk is assessed as being *broadly acceptable with embedded mitigation, and ALARP*. Should DEP and SEP both be constructed, the potential impacts would be the same as those if DEP and SEP were constructed in isolation (**minor adverse** in EIA terms). This is because while the overall offshore cable length would increase (**Table 15.2**), the cables in closest proximity to anchoring activity (the offshore export cables and landfall) would be the same as assessed for DEP and SEP in isolation and there would be no measurable increase in incident frequency or consequence.

15.6.1.5 Impact 5: Under Keel Clearance

15.6.1.5.1 DEP or SEP in Isolation

108. The use of external cable protection may be necessary if target burial depths cannot be met. This surface protection would be installed within the construction period and could lead to reductions in under keel clearance for passing vessels and potential grounding / interaction risks. During consultation the RYA raised concerns about under keel clearance, particularly close to the landfall, noting the potential for higher levels of non AIS traffic in this area. The RYA Coastal Atlas also shows that the offshore export cable corridor is within a “general boating area” on approach to landfall.

109. Equinor will consult with the MCA and Trinity House in any instances where water depths are reduced by more than 5% as a result of cable protection to determine whether additional mitigation is necessary to ensure the safety of passing vessels.

110. Horizontal Directional Drilling (HDD) will be likely be used an export cable landfall with exit pits offshore in an area of between 8m and 10m water depth, potentially reducing the likelihood of interaction near landfall, although final design options will be considered in full detail when known. The frequency is assessed as extremely unlikely and severity of consequence is moderate. In FSA terms under keel clearance is determined to be *broadly acceptable and ALARP* resulting in a **minor adverse** significance in EIA terms for both DEP and SEP in isolation.

15.6.1.5.2 DEP and SEP Together

111. In FSA terms the likely navigation safety the risk is assessed as being *broadly acceptable with embedded mitigation, and ALARP.* Should DEP and SEP be constructed concurrently, the potential impacts would be the same as those if DEP and SEP were constructed in isolation (**minor adverse**). This is because while the overall offshore cable length would increase (**Table 15.2**) the cables in shallow water (the offshore export cable corridor on approach to landfall) would be the same as assessed in isolation and there would be no measurable increase in incident frequency or consequence.

15.6.1.6 Impact 6: Emergency Service

15.6.1.6.1 DEP or SEP in Isolation

112. Construction traffic will lead to an increased number of vessels and personnel in the study area, and as such there may be an increase in the number of incidents requiring emergency response.

113. Existing incident rates are considered low in the study area based on the data studied within the NRA (**Appendix 15.1**), and it is not anticipated that SEP and DEP would notably increase the observed existing incident rates.

114. Further, it should be considered that the on-site presence of vessels associated with SEP and DEP construction will form additional resource to respond to any incidents in the area in liaison with the MCA, both in terms of incidents associated with DEP and SEP (i.e., self-help resources), but also incidents occurring outside of the arrays to third party vessels. As required under MGN 543, Equinor will produce and submit an ERCoP to the MCA detailing how they would cooperate and assist in the event of an incident.

115. Given the embedded mitigation, an extremely unlikely frequency (noting low baseline incident rates) is assigned and a serious consequence. In FSA terms the impacts on emergency response is assessed as being *broadly acceptable and ALARP*. The impact is therefore of **minor adverse** significance in EIA terms for both DEP and SEP in isolation.

15.6.1.6.2 DEP and SEP Together

116. In FSA terms the safety risk associated with emergency response for DEP and SEP together is assessed as being *broadly acceptable and ALARP*. Should DEP and SEP be constructed concurrently, there would be an increase in vessels and personnel across the study area during construction but not so much that the potential impacts would measurably increase from that each in isolation (**minor adverse** in EIA terms) given coordination of construction activities and embedded mitigation.

15.6.2 Potential Impacts during Operation

15.6.2.1 Impact 1: Displacement of Activities

15.6.2.1.1 DEP or SEP in Isolation

117. During the operational phase, there would be restrictions on entry into the wind farm sites via safety zones around major maintenance work. Given the separation distance of turbines of 990m, usage of the operational area outside of safety zones is accommodated. That said, vessels, particularly commercial vessels, are likely to avoid operational areas, and thus the DEP and SEP wind farm sites.

118. Maintenance associated with offshore cables (infield, interlink and export) may also temporarily displace traffic, however operations will be transient, localised, effectively communicated and managed and have minimal impacts.

119. DEP and SEP are largely outside the highest density traffic areas (**Plate 15-1**), however vessels, including cargo, tanker, oil and gas, wind farm, aggregate dredger passenger, fishing and recreation within the study area could be displaced from the DEP and SEP wind farm sites during operation.

120. In order to manage displacement impacts Equinor will communicate information to ensure third party vessels are aware of maintenance activities and display information on charts. Further, vessel traffic will be monitored three years after construction within the operational period.

121. Effects on each receptor (main vessel types identified in **Section 15.5**) are outlined in the following sections (with differentiation between the DEP and SEP highlighted where differences are identified).

Commercial Vessels

122. Commercial vessels (including cargo, tanker and passenger) are those found most frequently within the study area and most likely to avoid operational areas, with a minimum distance of 1nm assumed between shipping routes and the DEP and SEP wind farm site boundaries.

123. In terms of main routes, the Tees to Rotterdam main route intersects the DEP North wind farm site boundary, and the Humber to Rotterdam route intersects the DEP South wind farm site boundary. Displacement to these routes to both the east and west of the DEP boundary would result during operation, with at worst case a 4% change in route length.

124. During operation SEP is likely to cause slight displacement to the Hull to Zeeburgge and Hull to Rotterdam routes which runs parallel to the northeastern edge of the SEP wind farm site boundary. Displacement would cause the route to move eastwards, worst case showing a 0.1% change in route length.

Oil and Gas Vessels

125. Disturbance to vessels in transit includes the Great Yarmouth to Lancelot main route, where a 4% change in route length is predicted due to the presence of the DEP wind farm site. Other displacement effects would be as described for construction **Section 15.6.1.1**.

126. Considering vessels not in transit (associated with platforms) there is a 500m safety zone around oil and gas platforms where support vessels operate. Other larger vessels are also associated with operations that may also be stationed around the platform. Access to the south of the Waveney platform (and the planned Blythe platform) may be restricted given the boundary of DEP is 500m from the Waveney platform and vessel tracks show usage beyond the 500m safety zone. Impacts to oil and gas operations are further assessed in **Chapter 18 Petroleum Industry and Other Marine Users**, noting a detailed assessment of both marine and airborne access to oil and gas platforms is underway and will be included in the ES. Further consultation will be also be required to establish both the planned and emergency access requirements of the platforms, which will also be part of layout planning, to determine the full extent of access restrictions and mitigation that facilitate safe coexistence.

Wind Farm Support Vessels

127. Windfarm support vessels in the study area are predominately made up of those supporting the parent Dudgeon and Sheringham OWFs which are mainly located within the operational boundary of the parent sites as well as those in transit to race back OWF. There will be access of the operational area available to wind farm vessels.

Aggregate Dredgers

128. As described for construction effects, aggregate dredgers would experience a level of disruption, although marine aggregate dredgers would be free to transit through the wind farm sites given the turbine spacing of 990m. There are however also, as identified in the NRA, alternate routeing options to the Outer Dowsing aggregate production areas as follows:

- Vessels accessing area 515/1 that intersect the DEP wind farm South site can make a minor deviation to the south; and
- Vessels accessing area 515/2 that intersect the DEP wind farm North site can either pass east, or deviate further west, and pass north avoiding the Outer Dowsing shallows.

Recreational Vessels

129. Recreational vessels make up a small proportion of overall vessel activity within the study area and are predominantly associated inshore of both DEP and SEP wind farm site boundaries (where displacement would primarily occur). Displacement could occur within the DEP and SEP wind farm site boundaries during maintenance activities, although vessels would largely be would be free to transit through the wind farm sites given the turbine spacing of 990m.

130. Recreational vessels are associated with the coast in higher numbers, any cable maintenance will be short term and communicated effectively to reduce disturbance.

Fishing Vessels

131. Fishing vessels would be displaced by operational maintenance activities, and as shown by the limited numbers of vessels seen within the parent sites, also likely to avoid the DEP and SEP wind farm boundaries. However, fishing vessels show limited use of the DEP and SEP wind farm boundaries for active fishing. Displacement to fishing activity and economic effects are further considered in **Chapter 13 Commercial Fisheries**.

Overall Assessment

132. Displacement will occur daily, thus at a frequent frequency for all receptors during operation. The severity of consequence is negligible given the level of disturbance and deviations required as well as mitigation in place to manage and communicate maintenance activities. The overall assessment in the FSA (Appendix 15.1) is *tolerable with additional mitigation, and ALARP*. The impact of displacement is therefore of **moderate adverse** significance in EIA terms for both DEP and SEP in isolation.

133. Adverse weather routes are identified in the study area and includes the DFDS beach route. However routes, as discussed in the NRA, are either unaffected by DEP and SEP or there is considered to be sufficient sea room between the SEP and DEP wind farm sites to accommodate safe transit including in adverse conditions and the overall assessment above applies.

15.6.2.1.2 DEP and SEP Together

134. Potential impacts to all vessel types would be the same (**moderate adverse**) as for DEP and SEP in isolation given route deviations would not measurably increase in terms of the deviation percentage. This is detailed further within the NRA whereby the deviation to routes is detailed for DEP and SEP in isolation and together.

15.6.2.2 Impact 2: Increased Collision Risk

15.6.2.2.1 DEP or SEP in Isolation

135. Vessel to vessel, and project vessels to third party vessel collision risk may be increased by the physical presence of structures restricting navigable routes and displacing vessels, and the presence of project vessels associated with maintenance works increasing vessel numbers within the study area.

136. Based upon the pre wind farm modelling undertaken within the NRA, baseline collision rates in the study area are high, with a vessel estimated as being involved in a collision once per 9.6 years. This broadly aligns with the baseline incident data studied, with the MAIB data showing that one collision occurred within the study area between 2008 and 2017. This high collision rate is due to the high volumes of vessels utilising similar passage.

137. Collision risk modelling using vessel traffic data and conservative route deviations has been undertaken within the NRA considering a number of scenarios including:

- Pre wind farm with base case vessel traffic levels;
- Pre wind farm with future case vessel traffic levels;

- Post wind farm with base case vessel traffic levels for DEP and SEP in isolation and together; and
- Post wind farm with future case vessel traffic levels for DEP and SEP in isolation and together.

138. Collision rates (modelling results) are given in **Table 15.10** below:

Table 15.10: Collision rates in isolation

Scenario	0% (base traffic)	10% (traffic increase)	20% (traffic increase)
DEP Only pre- wind farm	1 per 10 years	1 per 8 years	1 per 7 years
DEP Only post- wind farm	1 per 9 years	1 per 7 years	1 per 6 years
SEP Only pre-wind farm	1 per 10 years	1 per 8 years	1 per 7 years
SEP Only post-wind farm	1 per 9 years	1 per 8 years	1 per 7 years

139. Operational traffic associated with the existing Dudgeon and Sheringham Shoal OWF sites, means vessels will be familiar with wind farm traffic in the area. Further, given the embedded mitigation (that is tried and tested within the industry) and operational procedures the assigned frequency is remote and the consequence is serious. In FSA terms the assessment for collision is *broadly acceptable, and ALARP* (third party to project vessels) and *tolerable with additional mitigation and ALARP* (third party to third party vessels). The impact therefore is of **moderate adverse** significance in EIA terms.

140. Consultation will be undertaken with the MCA, Trinity House and other interested parties to determine whether any additional measures should be put in place to manage collision risk.

15.6.2.2.2 DEP and SEP Together

141. It is estimated within the NRA that a vessel would be involved in a collision once every 8 years for the base case (**Table 15.11**), which represents a 13% increase over the pre-wind farm base case. Future case collision risk increases to 1 per 7 years and 1 per 6 years for the 10% and 20% traffic increases, respectively.

Table 15.11 Collision rates for DEP and SEP together

Scenario	0% (base traffic)	10% (traffic increase)	20% (traffic increase)
DEP and SEP pre-wind farm	1 per 10 years	1 per 8 years	1 per 7 years
DEP and SEP post-wind farm	1 per 8 years	1 per 7 years	1 per 6 years

142. The greatest increases in collision risk, assessed within the NRA, were observed to be associated with the routes that passed between the DEP and SEP wind farm sites, which is reflective of a reduced width (**Plate 15-3**) within which vessels will be able to transit following construction of the wind farms.

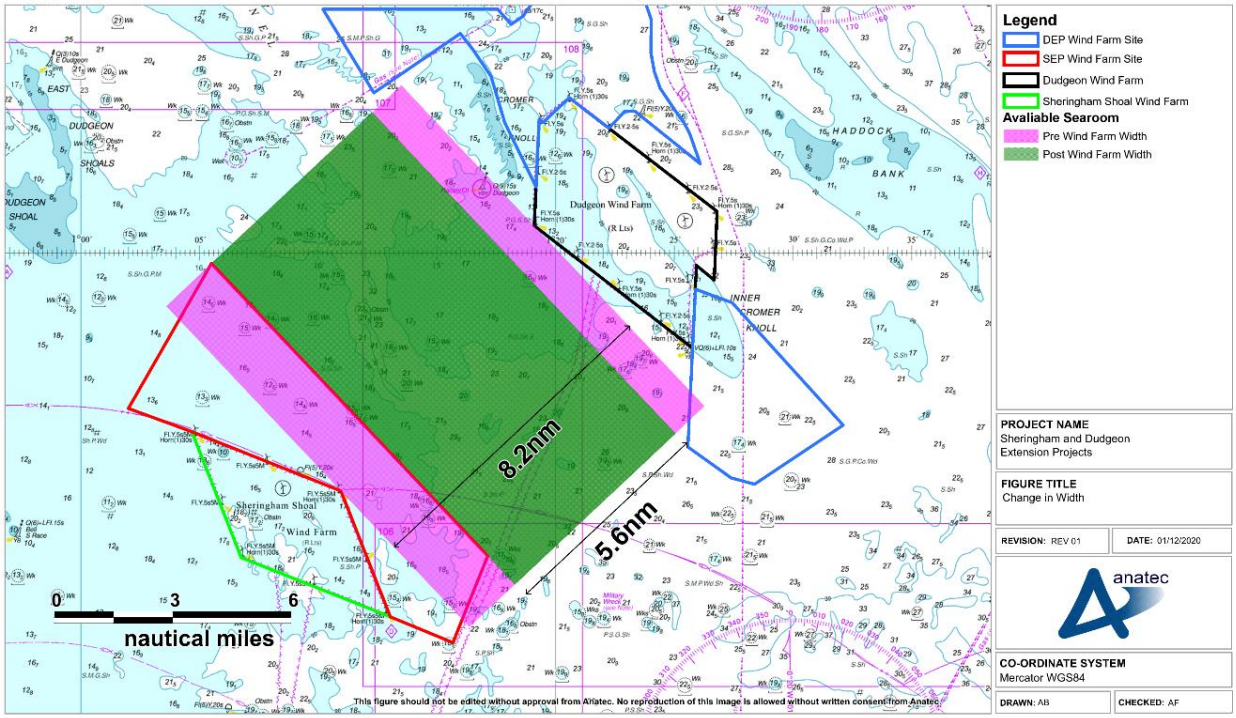

Plate 15-3: Reduction in Available Searoom

143. As detailed in the NRA while the available searoom is compliant with the MGN 543 width requirements, there is a reduction in width between the existing Dudgeon and Sheringham Shoal OWF sites (8.2nm reduced to 5.6nm if both DEP and SEP were built). This reduction in searoom and volume of traffic was raised as a concern during consultation.

144. Operational traffic associated with the existing Dudgeon and Sheringham Shoal OWF sites, means vessels will be familiar with wind farm traffic in the area. Further, given the embedded mitigation (that is tried and tested within the industry) and operational procedures the assigned frequency is remote and the consequence is serious. In FSA terms the assessment for collision is *tolerable with additional mitigation and ALARP* for vessel to vessel and broadly acceptable for third party to project vessel. The impact therefore is of **moderate adverse** significance in EIA terms. However, following further analysis and consultation to agree suitable additional mitigation it is expected that the level of impact can be reduced.

15.6.2.3 Impact 3: Increased Allision Risk

15.6.2.3.1 DEP or SEP in Isolation

145. The physical presence of structures would create a vessel to structure allision risk for a vessel navigating within the study area.

146. Commercial vessels (cargo, tanker and passenger) as well as dredgers, which account for the majority of vessels recorded in the study area, would likely avoid the DEP and SEP boundaries and not be exposed to allision risks. Other vessels types are discussed below.

147. Wind farm vessels in particular are likely to have crew who are experienced in safely transiting OWF sites, and those associated with the operational Dudgeon and Sheringham Shoal wind farm will also be experienced in working in the local maritime environment.

148. Oil and gas support vessels associated with the Waveney platform spend longer in the DEP North boundary than other vessels in transit and may experience increased allision risk, given access requirements to the platform. Allision risk to vessels in transit is within the scope of the NRA, whereas vessels associated with servicing the platforms upon arrival is not. Thus, further consultation with the operators, Perenco, to identify any specific mitigation is required in relation to DEP impacts on oil and gas vessels and access arrangements at Waveney. This also applies to the Blythe platform (Independent Oil and Gas) where construction near the DEP South boundary may impact access. A detailed assessment of both marine and helicopter access and potential restrictions is being undertaken alongside consultation for inclusion in the ES, with results to be contained within **Chapter 18 Petroleum Industry and Other Marine Users**, noting a detailed assessment of both marine and airborne access to oil and gas platforms is underway and will be included in the ES.

149. Fishing vessels engaged in fishing are at increased risk given the increased time spent in proximity to structures, compared to passing vessels, however as described in **Section 15.5**, fishing activity is low within the SEP and DEP wind farm site boundaries where allision risk would occur.

150. Recreation vessels are present in very low numbers within the DEP and SEP wind farm boundaries where allision risk would occur, with any vessels also likely to be traveling at low speeds which would reduce the severity of consequence.

151. Allision incidents between a vessel and a wind turbine (under construction, operational or disused) in the UK are low with an average of 1 per 1,620 years including both operational and non-operational turbines.

152. Based on the allision modelling (**Table 15.12**) undertaken as part of the NRA, it is estimated that an allision under power with a structure within the wind farm sites would occur once per 647 years (DEP) and once per 1,415 years (SEP) for the base case. Drifting rates are 1,139 years (DEP) and once per 802 years (SEP) for the base case.

Table 15.12: Allision rates in isolation post windfarm

Scenario	0% (base traffic)	10% (traffic increase)	20% (traffic increase)
DEP Only powered	1 per 647 years	1 per 610 years	1 per 563 years
DEP Only drifting	1 per 1,139 years	1 per 929 years	1 per 854 years

Scenario	0% (base traffic)	10% (traffic increase)	20% (traffic increase)
SEP Only powered	1 per 1,415 years	1 per 1,286 years	1 per 1,180 years
SEP Only drifting	1 per 802 years	1 per 728 years	1 per 668 years

153. Experience from existing OWFs and consultation, as further discussed in the NRA, show that commercial vessels will avoid the DEP and SEP operational wind farm sites. Minimum turbine spacing of 990m is considered as being sufficient to accommodate safe transit, allowing other vessels to maintain safe distances from structures (and hence minimising allision risk). Further, Equinor has developed a set of Layout Rules, which include commitment to ensuring straight line edges without dangerously protruding or isolated structures. The layout will be agreed with the MCA and Trinity House.

154. The frequency of allision events is remote and the consequence serious. In FSA terms the assessment for allision is *tolerable with embedded mitigation, and ALARP*. The impact is therefore of **moderate adverse** significance in EIA terms.

15.6.2.3.2 DEP and SEP Together

155. In FSA terms the assessment for allision *tolerable with embedded mitigation, and ALARP.* Potential impacts in EIA terms would be the same DEP and DEP in isolation (**moderate adverse**) because there would not be a marked (**Table 15.13**) increase in terms of likelihood of allision events or consequence.

Table 15.13: Allision rates together post windfarm

Scenario	0% (base traffic)	10% (traffic increase)	20% (traffic increase)
DEP and SEP powered	1 per 470 years	1 per 425 years	1 per 390 years
DEP and SEP drifting	1 per 750 years	1 per 682 years	1 per 626 years

15.6.2.4 Impact 4: Interaction with Subsea Cables

15.6.2.4.1 DEP or SEP in Isolation

156. Vessel count observations, during the 28 day survey (**Section 15.4.2**) showed the majority of anchored vessels were near the landfall, comprising of mainly oil and gas support vessels and cargo vessels. An average of approximately one unique vessel every two days was determined to be at anchor during the survey period within the offshore export cable corridor shipping and navigation study area. The closest anchored vessel to the export cable corridor was an oil and gas vessel situated approximately 0.36nm from the export cable corridor.

157. Scenarios that could lead to cable interaction during operation are as per construction (**Section 15.6.3.4**) but associated with fully completed cables.

158. Horizontal Directional Drilling (HDD) will be likely be used an export cable landfall with exit pits offshore in an area of between 8m and 10m water depth, potentially reducing the likelihood of interaction near landfall, although final design options will be considered in full detail when known.

159. Given the vessel traffic and baseline anchoring activity within the SEP and DEP export cable study area, embedded mitigation and the likelihood of interaction the frequency is extremely unlikely and the severity of consequence is moderate. In FSA terms cable interaction is assessed as *being broadly acceptable with embedded mitigation, and ALARP*, resulting in a **minor adverse** significance in EIA terms.

15.6.2.4.2 DEP and SEP Together

160. In FSA terms the risk is assessed as being broadly *acceptable with embedded mitigation, and ALARP*. In EIA terms the impact would be the same as for DEP and SEP in isolation (**minor adverse**). This is because while the overall offshore cable length would be greater (**Table 15.2**), the extent of cables in closest proximity to anchoring activity (the offshore export cables approaching landfall) would be the same there would be no measurable increase in frequency or consequence.

15.6.2.5 Impact 5: Under Keel Clearance

15.6.2.5.1 DEP or SEP in Isolation

161. The impacts is as described per construction effects (**Section 15.6.1.5**) and during operation cable protection monitoring will be undertaken. Equinor will consult with the MCA and Trinity House in any instances where water depths are reduced by more than 5% as a result of cable protection to determine whether additional mitigation is necessary to ensure the safety of passing vessels.

162. There are no significant impacts identified in relation to sediment transport and scour (**Chapter 8 Marine Geology, Oceanography and Physical Processes**), however any changes in depths associated with scour or sediment transportation which may impact upon navigational safety will be discussed with the MCA and Trinity House to determine any required mitigation.

163. The frequency is extremely unlikely and the consequence is moderate. In FSA terms the risk is determined to be *broadly acceptable and ALARP* and the impact is assessed as being **minor adverse** significance in EIA terms.

15.6.2.5.2 DEP and SEP Together

164. Potential impacts would be the same as those if DEP and SEP in isolation (**minor adverse**) because while the total length of cable would be greater **(Table 15.2)** the cables in shallow water (the offshore export cable corridor on approach to landfall) would be the same and there would be no measurable increase the incident frequency or consequence.

15.6.2.6 Impact 6: Emergency Service

15.6.2.6.1 DEP or SEP in Isolation

165. Operation and maintenance traffic will lead to an increased level of vessels and personnel in the study area. As a result, there may be an increase in the number of incidents requiring emergency response.

The final layout of the DEP and SEP wind farm sites will be agreed with the MCA and Trinity House post consent as required under the DCO, and these discussions will include SAR considerations. It is also noted that the Layout Rules include provision for facilitating SAR access, in that so far as is practicable, all wind turbines will be arranged in straight lines in an easily understandable pattern within individual wind farm site layouts, avoiding structures which break this pattern.

166. Existing incident rates are considered low in the study area based on the data studied within the NRA (**Appendix 15.1**), and it is not anticipated that DEP or SEP would notably increase the observed existing incident rates.

167. As per construction, an extremely unlikely frequency (noting low baseline incident rates) and serious consequence is assigned. In FSA terms FSA impact to emergency response impacts is assessed as being *broadly acceptable and ALARP*. The impact is therefore of **minor adverse** significance in EIA terms.

15.6.2.6.2 DEP and SEP Together

168. In FSA terms FSA impact to emergency response impacts is assessed as being *broadly acceptable and ALARP*. In EIA terms, with DEP and SEP operational at the same time, there would be an increase in vessels and personnel across the study area during operation but the potential impacts would not increase from that in isolation (**minor adverse**) given coordination of maintenance activities and embedded mitigation.

15.6.3 Potential Impacts during Decommissioning

15.6.3.1 Impact 1: Displacement of Activities

15.6.3.1.1 DEP or SEP in Isolation

169. Displacement of vessels within the study area could arise from the physical presence of structures undergoing decommissioning. As well as vessel associated with decommissioning of the inter array and offshore cables.

170. Buoyed areas would be established during decommissioning activities but allow vessels access to areas not being worked on. Notice to Mariners and other methods of communication would also ensure that vessels are able to effectively plan to minimise deviations.

171. In FSA terms displacement is assessed as being *tolerable with additional mitigation, and ALARP* across the project lifecycle. As per construction, **Section 15.6.1**, each receptor will experience displacement to a varying degree, depending on frequency of use and geographical spread across the study area. Given that the worst case scenario for decommissioning considers the same parameters as construction (and the same embedded mitigation will be in place) the impacts in EIA terms are considered to be the same (of **moderate adverse** significance) as during construction, with detailed mitigation measures to be identified within the Decommissioning Plan.

15.6.3.1.2 DEP and SEP Together

172. In FSA terms displacement is assessed as being tolerable with *additional mitigation, and ALARP* across the project lifecycle, as per in isolation. Should DEP and SEP both be decommissioned concurrently the potential impact significance in EIA terms would be the same (**moderate adverse**) as if they were to be decommissioned separately (**Section 15.6.1.1.1**). This is because there would be no overlap in decommissioning areas and buoyed areas would be rolling, coordinated and allow flexible access.

15.6.3.2 Impact 2: Increased Collision Risk

15.6.3.2.1 DEP or SEP in Isolation

173. During decommissioning there would an increase in vessels associated with decommissioning activities. In FSA terms the increase in collision risk for DEP and SEP in isolation (covering the entire project lifecycle) between third party vessels is assessed as being *tolerable with additional mitigation and ALARP* and *broadly acceptable and ALARP* for third party to project vessels.

174. The impact is not expected to be greater than that during construction or operation, noting minimal commercial vessels are likely to be transiting through the DEP and SEP wind farm boundary during operation. Resulting encounters and vessel to vessel collision risk is, at worst case, anticipated to be comparable to the construction phase and as such would be of **moderate adverse** significance in EIA terms.

15.6.3.2.2 DEP and SEP Together

175. In FSA terms the increase in collision risk for DEP and SEP in isolation (covering the entire project lifecycle) between third party vessels is assessed as being tolerable with additional mitigation and ALARP and broadly acceptable and ALARP for third party to project vessels. Should DEP and SEP both be decommissioned concurrently, the potential collision impacts would be the same (**moderate adverse** in EIA terms) as if they were to be undertaken in isolation (**Section 15.6.1.1.1**). This is because there would be no overlap in buoyed areas and work areas would be rolling, coordinated and allow flexible access.

15.6.3.3 Impact 3: Increased Allision

15.6.3.3.1 DEP or SEP in Isolation

176. There is a potential for allision with structures not fully decommissioned. In FSA terms the impact across the project lifecycle is assessed as being *tolerable with embedded mitigation, and ALARP*. The impacts, up to the point that all surface infrastructure was decommissioned, and there would be no effect, would not differ greatly from the construction phase (**moderate adverse** significance in EIA terms) with the same embedded mitigation. This includes safety zones and guard vessels where required that will prevent vessels approaching areas not fully decommissioned and charted presence of structures left *in situ*.

15.6.3.3.2 DEP and SEP Together

177. In FSA terms the impact across the project lifecycle is assessed as *being tolerable with embedded mitigation, and ALARP*. Should DEP and SEP be decommissioned concurrently the potential allision impacts would be the same (**moderate adverse** significance in EIA terms) as DEP and SEP in isolation. This is because there would be no spatial overlap or measurable effects on the frequency or severity of impacts.

15.6.3.4 Impact 4: Interaction with Subsea Cables

15.6.3.4.1 DEP or SEP in Isolation

178. Cables would be removed, or decommissioned *in situ* with their presence charted. Snagging potential during and post decommissioning is considered the same as during construction and operation.

179. The frequency is low and with third partly impacts most probably related to the loss of fishing gear, the consequence is low. In FSA terms the impact across the project lifecycle is assessed as being broadly *acceptable with embedded mitigation, and ALARP*, resulting in a **minor adverse** significance in EIA terms.

180. It is noted that cable monitoring will not be in place as standard, although future case monitoring will be considered in the Decommissioning Plan alongside data from the operational phase.

15.6.3.4.2 DEP and SEP Together

181. In FSA terms the impact across the project lifecycle is assessed as being *broadly acceptable with embedded mitigation, and ALARP*. In EIA terms the impact would be the same as if they are decommissioned in isolation (**minor adverse**) there would be no measurable increase in the frequency or consequence.

15.6.3.5 Impact 5: Under Keel Clearance

15.6.3.5.1 DEP or SEP in Isolation

182. When considering the impact where cables are decommissioned *in situ*, effects will be expected to be the same as during operation. In FSA terms the impact is *broadly acceptable and ALARP* (**minor adverse** significance in EIA terms).

15.6.3.5.2 DEP and SEP Together

183. Considering DEP and SEP together, the potential impacts would be the same as those in isolation (*broadly acceptable and ALARP* in FSA terms and **minor adverse** in EIA terms) because there would be no measurable increase in the frequency or consequence of incident.

15.6.3.6 Impact 6: Emergency Service

15.6.3.6.1 DEP or SEP in Isolation

184. Decommissioning of SEP and DEP will lead to an increased level of project vessels and personnel in the area, and as such there may be an increase in the number of incidents requiring emergency response.

185. The impact is considered to reflect the assessment during construction. In FSA terms the impact is assessed as being *broadly acceptable and ALARP*, resulting in a **minor adverse** significance in EIA terms.

15.6.3.6.2 DEP and SEP Together

186. Should DEP and SEP be decommissioned concurrently, there would be an increase in vessels and personnel across the study area but not so that the potential impacts would increase from that in isolation. In FSA terms the impact is assessed as being *broadly acceptable and ALARP* (**minor adverse** in EIA terms) given coordination of activities.

15.7 Cumulative Impacts

15.7.1 Identification of Potential Cumulative Impacts

187. The first step in the cumulative assessment is the identification of which residual impacts assessed for DEP and/or SEP on their own have the potential for a cumulative impact with other plans, projects and activities (described as 'impact screening'). This information is set out in **Table 15.14** below, together with a consideration of the confidence in the data that is available to inform a detailed assessment and the associated rationale. Only potential impacts assessed as negligible or above in **Section 15.6** are included in the CIA (i.e. those assessed as 'no impact' are not taken forward as there is no potential for them to contribute to a cumulative impact).

188. **Table 15.14** concludes that in relation to Shipping and Navigation where effects are very localised (under keel clearance and cable route interactions) there is no potential for interaction with other projects that would cause cumulative effects. Where impacts relate to vessel movement across the study area there is the potential for cumulative effects, and other plans and projects also have the potential to change existing traffic levels and distributions.

Table 15.14 Potential Cumulative Impacts (impact screening)

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Construction			
Impact 1: Displacement	Yes	Medium	There is the potential for interaction which may lead to cumulative displacement.
Impact 2: Collision risk	Yes	Medium	There is the potential for interaction which may lead to cumulative collision risk.
Impact 3: Allision risk	Yes	Medium	There is the potential for interaction which may lead to cumulative allision risk.

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Impact 4: Interaction with subsea cables	No	Medium	The risk is localised with no interaction with other cables or cumulative projects. Existing cables be considered within the Cable Burial Risk Assessment undertaken for DEP and SEP. The developers of any future cables in proximity would be undertaking their own similar assessments. On this basis, project alone impacts remain.
Impact 5: Under keel clearance	Yes	Low	There is the potential for interaction which may lead to cumulative impacts.
Impact 6: Emergency response	Yes	Medium	There is the potential for interaction which may lead to cumulative pressure on emergency response.
Operation			
Impact 1: Displacement	Yes	Medium	There is the potential for interaction which may lead to cumulative displacement and rerouting.
Impact 2: Collision risk	Yes	Medium	There is the potential for interaction which may lead to cumulative collision risk.
Impact 3: Allision risk	Yes	Medium	There is the potential for interaction which may lead to cumulative allision risk.

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Impact 4: Interaction with subsea cables	No	Medium	The risk is localised with no interaction with other cables or cumulative projects. Existing cables will be considered within the Cable Burial Risk Assessment undertaken for the SEP and DEP. The developers of any future cables in proximity would be undertaking their own similar assessments. On this basis, project alone impacts reside.
Impact 5: Under keel clearance	Yes	Medium	There is the potential for interaction which may lead to cumulative impacts.
Impact 6: Emergency response	Yes	Medium	There is the potential for interaction which may lead to cumulative pressure on emergency response.
Decommissioning			
Impact 1: Displacement	Yes	Medium	There is the potential for interaction which may lead to cumulative displacement.
Impact 2: Collision risk	Yes	Medium	There is the potential for interaction which may lead to cumulative collision risk.
Impact 3: Allision risk	Yes	Medium	There is the potential for interaction which may lead to cumulative allision risk.

Impact	Potential for Cumulative Impact	Data Confidence	Rationale
Impact 4: Interaction with subsea cables	No	Medium	The risk is localised with no interaction with other cables or cumulative projects. Existing cables will be considered within the Cable Burial Risk Assessment undertaken for the SEP and DEP. The developers of any future cables in proximity would be undertaking their own similar assessments. On this basis, project alone impacts reside.
Impact 5: Under keel clearance	Yes	Medium	There is the potential for interaction which may lead to cumulative impacts.
Impact 6: Emergency response	Yes	Medium	There is the potential for interaction which may lead to cumulative pressure on emergency response.

15.7.2 Other Plans, Projects and Activities

189. The second step in the cumulative assessment is the identification of the other plans, projects and activities that may result in cumulative impacts for inclusion in the CIA (described as 'project screening'). This information is set out in **Table 15.15** (noting the same list of projects applies during construction, operation and decommissioning) , together with a consideration of the relevant details of each, including current status (e.g. under construction), planned construction period, closest distance to DEP and SEP, status of available data and rationale for including or excluding from the assessment. It is noted that for shipping and navigation, operation developments are considered within the existing environment and not cumulatively.

190. The project screening has been informed by the development of a CIA Project List which forms an exhaustive list of plans, projects and activities in a very large study area relevant to DEP and SEP. The list has been appraised, based on the confidence in being able to undertake an assessment from the information and data available, enabling individual plans, projects and activities to be screened in or out. For this chapter a tier classification has also been determined as detailed in the NRA (**Appendix 15.1**).

Table 15.15: Summary of projects considered for the CIA

Project	Status	NRA Tier	Closest Distance from the Project (km)	Confidence in Data	Included in the CIA (Y/N)	Rationale
Triton Knoll OWF	Under Construction	1	7.2	High	Yes	Within 100nm and has an effect on cumulative routeing
Norfolk Vanguard OWF	Consented	1	31.5	High	Yes	Within 100nm and has an effect on cumulative routeing
Norfolk Boreas OWF	Under determination	1	44.7	High	Yes	Within 100nm and has an effect on cumulative routeing
East Anglia THREE	Consented	2	51.1	High	Yes	Within 100nm and has an effect on cumulative routeing
East Anglia ONE North	Under Examination	2	53.0	Medium	Yes	Within 100nm and has an effect on cumulative routeing
East Anglia TWO	Consent Submitted	2	56.7	Medium	Yes	Within 100nm and has an effect on cumulative routeing
Mermaid	Under Construction	2	96.7	Medium	Yes	Wind farm within 100nm
Hornsea Project Two OWF	Under Construction	3	28.3	High	Yes	Within 100nm and has an effect on cumulative routeing

Project	Status	NRA Tier	Closest Distance from the Project (km)	Confidence in Data	Included in the CIA (Y/N)	Rationale
Hornsea Project Four	Scoped	3	28.5	Medium	Yes	Preapplication wind farm within 100nm
Hornsea Project Three OWF	Consented	3	44.6	High	Yes	Wind farm within 50nm
Five Estuaries	Pre Scoping	3	72.7	Low	Yes	Wind farm within 100nm
North Falls	Pre Scoping	3	75	Low	Yes	Wind farm within 100nm
Dogger Bank A	Consented	3	80.5	High	Yes	Wind farm within 100nm
Dogger Bank B	Consented	3	93.6	High	Yes	Wind farm within 100nm
Sofia	Consented	3	93.6	High	Yes	Wind farm within 100nm

15.7.3 Assessment of Cumulative Impacts

191. Having established the residual impacts from DEP and/or SEP with the potential for a cumulative impact, along with the other relevant plans, projects and activities, the following sections provide an assessment of the level of cumulative impacts that may arise. Within the FSA the cumulative safety risks for DEP and SEP in isolation are assessed to be the same as the projects in isolation.

15.7.3.1 Displacement of Activities

192. A cumulative deviation assessment of the main routes and adverse weather routing within the NRA identified that cumulative increases in existing vessel routeing represented only minor increases in journey distances. Sea space is unaffected when the projects screened into the cumulative assessment are incorporated and adverse weather routes are not anticipated to be impeded. In FSA terms the risk is *broadly acceptable and ALARP*. This reduction to project alone impacts reflects the greater cumulative study area.

193. Given the distances and orientation of cumulative projects from DEP and SEP the impacts in EIA terms is the same as DEP and SEP together **moderate adverse**.

15.7.3.2 Vessel to Vessel Collision

194. There is no notable change in sea space and vessel traffic when the cumulative projects are incorporated. Given Lowestoft and Great Yarmouth are likely to be utilised for base ports for future wind farm projects, there may be an increase in wind farm associated traffic on a cumulative basis as other projects are being constructing. However, all developers should be establishing appropriate vessel management procedures (e.g., marine coordination, transit routes, site access points), and it is noted that vessels in the study area will be familiar with wind farm traffic in the area. In FSA terms vessel to vessel collision is assessed as being *tolerable with mitigation and ALARP* and third party to project vessels is assessed as being *broadly acceptable and ALARP*.

195. Given the distances and orientation of cumulative projects from DEP and SEP the impact in EIA terms is the same as DEP and SEP together, **moderate adverse**.

15.7.3.3 Vessel to Structure Allision

196. As highlighted above sea space is unaffected when the screened in cumulative projects are incorporated. Lighting and marking will require cumulative consideration, and requirements will be discussed and agreed with key stakeholders, including Trinity House and the MCA. In FSA terms vessel to vessel collision is assessed as being *tolerable with embedded mitigation and ALARP*

197. Given the distances and orientation of cumulative projects from DEP and SEP the impact in EIA terns is the same as DEP and SEP together **moderate adverse**.

15.7.3.4 Changes in Under Keel Clearance

198. Any future OWF projects will be required to have similar discussions with the MCA under MGN 543 regarding changes in water depth of greater than 5%.

199. Effects will be localised to each project and Interaction between DEP and SEP with cumulative projects in terms of under keel clearance is limited and in FRA terms the impact is assessed as being *broadly acceptable and ALARP.*

200. Given the distances and orientation of cumulative projects from DEP and SEP the impact is the same as DEP and SEP together (**minor adverse**).

15.7.3.5 Emergency Response

201. An increase in incident rates may arise as a result of DEP and SEP in combination with other projects, leading to an effect on emergency response resources.

202. Given the low baseline incident rates (**Section 15.5.3**), and noting the additional "self-help" resources that would be available at other projects, it is not considered likely that there will be an adverse effect on emergency response resources on a cumulative level. In FSA terms the impact is assessed as being *broadly acceptable and ALARP.*

203. The final layout will be agreed with the MCA post-consent, and these discussions will include SAR considerations at a cumulative level. On this basis, the impact in EIA terms is the same as DEP and SEP together (**minor adverse**).

15.8 Transboundary Impacts

204. Transboundary impacts relate to impacts that may occur from an activity within one EEA state on the environment or interests of another. Given the international nature of shipping and navigation, as identified in **Section 15.5.4**, transboundary effects are possible. These are assessed in terms of impacts to international shipping routes in **Sections 15.6** and **15.7**. This includes effects on main routes with destinations at European ports such as Rotterdam (Netherlands) and Zeebrugge (Belgium).

205. Considering DEP in isolation three main routes with a European destination would be deviated (Tees (UK) / Rotterdam (Netherlands) and two Humber (UK) / Rotterdam (Netherlands) routes), with a maximum change of 4%. SEP in isolation would cause deviation to two main routes (Hull (UK) / Zeebrugge (Belgium) and Hull (UK) / Rotterdam (Netherlands)) by 0.1%.

206. Considering DEP and SEP together, while the total number of transboundary routes experiencing deviation would increase to six the change in distance to the routes would remain as per the sites in isolation.

207. EU member states will be included in all formal stages of consultation and it is also noted that the deviations highlighted above have been raised by one operator, P&O, who highlight the increased distance and fuel costs associated with the deviations.

208. As per the operational impacts on main routes, transboundary effects are expected at a frequent frequency and a negligible consequence given the minimal deviations that would be required as well as embedded mitigation in place to manage operational activities. The impact has therefore been classed as **moderate adverse** significance in EIA terms for DEP and SEP in isolation and together.

15.9 Inter-relationships

209. **Table 15.16** illustrates the inter-relationship between impacts discussed in this chapter and those discussed in other chapters.

Table 15.16 Shipping and navigation users inter-relationships

Topic and description	Related chapter	Where addressed in this chapter	Rationale
Construction			
Impacts on fishing vessels (displacement)	**Chapter 14 Commercial Fisheries**	The impact to vessel displacement and navigational safety are assessed in **Section 15.6**.	Displacement (and the safety implications) impacts based on vessel type and their usage of the study area are assessed in **Section 15.6**. Economic effects of displacement are considered in **Chapter 14 Commercial Fisheries**.
Interference with oil and gas operations	**Chapter 18 Petroleum Industry and Other Marine Users**	The impact to oil and gas vessels are assessed in **Section 15.6.**	Impacts on oil and gas vessels and platform access are assessed in **Section 15.6** and will be considered further during the consultation with operators as detailed in **Chapter 18 Petroleum Industry and Other Marine Users.**

Topic and description	Related chapter	Where addressed in this chapter	Rationale
Operation			
Changes to wave and tidal currents	**Chapter 8 Marine Geology, Oceanography and Physical Processes**	Oceanographic conditions are included within modelling scenarios within the NRA (**Appendix 15.1**)	Changes to waves and tidal currents are not predicted at a scale whereby the conditions inputted into modelling would show any measurable difference.
Collision and allision risk	**Chapter 14 Commercial Fisheries**	Allision and collision risk in **Section 15.6**.	Allision and collision risk modelling includes all vessel types. The number and vessel types associated with fishing are further defined within the **Chapter 14 Commercial Fisheries**.
Impacts on communications and SAR	**Chapter 17 Aviation and MOD**	The impacts to communication and emergency response vessels are considered in **Section 15.6.**	Vessel to vessel communication and vessel response are assessed in **Section 15.6** with impacts associated with aviation assessed in **Chapter 17 Aviation and MOD.**
Decommissioning			
As per construction			

15.10 Interactions

210. The impacts identified and assessed in this chapter have the potential to interact with each other. The areas of potential interaction between impacts are presented in **Table 15.17**. This provides a screening tool for which impacts have the potential to interact.

211. Within **Table 15.17** the impacts are assessed relative to each development phase (Phase assessment, i.e. construction, operation or decommissioning) to see if (for example) multiple construction impacts affecting the same receptor could increase the level of impact upon that receptor. Following this, a lifetime assessment is undertaken which considers the potential for impacts to affect receptors across all development phases.

Table 15.17: Interaction between impacts - screening

Potential Interaction between Impacts **Construction, operation and decommissioning phases**						
	Displacement	Collision Risk	Allision Risk	Interaction with subsea cables	Under keel clearance	Emergency response
Displacement	-	Yes	Yes	No	No	No
Collision Risk	Yes	-	Yes	No	No	Yes
Allision Risk	Yes	Yes	-	No	No	Yes
Interaction with subsea cables	No	No	No	-	Yes	Yes
Under keel clearance	No	No	No	Yes	-	No
Emergency response	No	Yes	Yes	Yes	No	-

212. The worst case impacts assessed within the chapter take these potential interactions into account, and therefore the impact assessments are considered conservative and robust and the levels of significance identified in **Sections 15.6** and **15.7** are not increased.

15.11 Potential Monitoring Requirements

213. The following monitoring (which will be developed and document further post PEIR) is proposed be undertaken, subject to agreement with stakeholders, in accordance with Standard navigation conditions for inclusion within DML for offshore renewable energy installations:

- Construction and post construction (over three years, unless agreed otherwise with the MMO) monitoring of marine traffic (by automatic identification system) with a report submitted each year to the MMO, Trinity House and the MCA.
- Aids to Navigation Management plan that remains functional throughout the lifetime of the Project with reporting to Trinity House.
- A swath bathymetric survey to IHO Order 1a of the installed cable route (post construction and decommissioning). Data is to be supplied to the MCA, UKHO and survey report to the MMO.
- Periodic monitoring of cable burial / protection with a risk based approach to the management (this work will be undertaken for engineering and asset integrity purposes, with the frequency determined by need).

15.12 Assessment Summary

214. This chapter has provided a characterisation of the existing environment for shipping and navigation based on existing datasets, long term AIS analysis and site specific survey. Analysis of the existing environment highlights the high levels of vessel passage between the operational Dudgeon and Sheringham Shoal OWF sites, with commercial vessels (including cargo, tanker and passenger) accounting for the majority of the traffic. Aggregate dredgers, oil and gas, wind farm support, fishing, and recreational vessels are also all active within the study area.

215. Assessment of the impacts across the project lifecycle, summarised in **Table 15.18** below, has established that there will be some residual impacts during the construction, operation and decommissioning phases of DEP and SEP. Cumulative impacts are not shown in the table as these are assessed as being the same as the project alone impacts (which consider DEP and SEP together) given the distance, orientation and therefore interaction of cumulative projects.

216. The assessment has been informed by the EIA scoping process, as well as consultation conducted as part of the development of the NRA, as well as the outcomes of the NRA and FSA. All impacts from both DEP and SEP in isolation, from DEP and SEP together, and on a cumulative basis are assessed as being at most *tolerable with additional mitigation and ALARP*.

217. Cable lay activities, interaction with cables once installed and reductions in under keel clearance are considered to be localised and, with the embedded mitigation outlined (largely associated with established communication procedures and use of HDD near landfall), are not significant in EIA terms.

218. Impacts on emergency response resources were assessed and given baseline incident rates and the additional “self-help” resources that would be available, are also not significant in EIA terms.

219. Access disruptions to the Waveney gas platform and possibly the soon to be installed Blythe Hub infrastructure, will require further analysis and consultation to ensure safe coexistence.

220. Disruption and deviations to all vessel types will occur at a high frequency resulting in moderate adverse effects and further consultation is required. Routes, including adverse weather routing, have been assessed for the entire project lifecycle, including future vessel traffic increase scenarios (increases of 10% and 20%). In terms of main routes, deviations would be required for six out of the 14 main routes identified within the study area assuming both the SEP and DEP are constructed, with a maximum 4% change in route length.

221. While deviations are considered minimal in terms of change in journey distance, the affected vessels are being displaced at a high frequency (and a significant impact) into a smaller navigable space (sea room) than is currently available, leading to increased encounters and collision risk. Collision and allision modelling was undertaken for DEP in isolation, SEP in isolation, and DEP and SEP together. Results show the annual vessel to vessel collision risk within the study area following installation of DEP and SEP for the base case traffic levels corresponds with a collision return period of approximately one in eight years (a 13% increase in collision frequency). The annual allision risk for the base case traffic levels, following construction of DEP and SEP, was estimated to correspond to an allision return period of approximately 470 years (powered) and 750 years (drifting). This presents a potential impact of moderate adverse significance in EIA terms for collision and allision and further consultation will be undertaken prior to the assessments being finalised, to detail and agree suitable mitigation.

222. Details of all embedded and additional mitigation requirements will be refined by continued consultation throughout the EIA process and in the process of finalising the NRA.

Table 15.18: Summary of potential impacts in EIA terms on shipping and navigation receptors

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Construction and Decommissioning						
Impact 1: Displacement (including adverse weather routing)	Commercial vessels, Windfarm support vessels, Oil and gas vessels, Aggregate dredgers, Fishing vessels, Recreational vessels	Frequent	Negligible	Moderate adverse	Communication of information, display information on charts, vessel traffic will be monitored, AtoN Management Plan.	Moderate adverse (additional mitigation required through continued consultation expected to reduce impacts to minor)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 2: Collision risk	All vessel types	Remote	Serious	Moderate adverse	Coordination and communication of information, vessels will also adhere to COLREGS (IMO, 1972) and SOLAS (1974), vessel traffic and encounters will be monitored and AtoN Management Plan.	Moderate adverse (mitigation considered embedded)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 3: Allision risk	All vessel types	Remote	Serious	Moderate adverse	Implementation of safety zones, adherence to layout rules and obtain layout approval, active communication of information, installation of temporary lighting and marking and the use of guard vessels.	Moderate adverse (mitigation considered embedded)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 4: Interaction with subsea cables	All vessel types	Extremely Unlikely	Moderate	Minor adverse	Communication of information, vessels compliant with COLREGS (IMO, 1972), RAM status displayed, minimum safe passing distance of cable laying vessels, guard vessels where appropriate, temporary buoyage as required where cables are not yet protected or buried and baseline anchoring activity included within the Cable Burial Risk Assessment.	Minor adverse (mitigation considered embedded)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 5: Under keel clearance	All vessel types	Extremely Unlikely	Moderate	Minor adverse	Consultation with the MCA and Trinity House in any instances where water depths are reduced by more than 5% as a result of cable protection to determine whether additional mitigation is necessary to ensure the safety of passing vessels.	Minor adverse

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 6: Emergency response	All vessel types	Extremely Unlikely	Serious	Minor adverse	Adherence with COLREGS (IMO, 1972) and SOLAS (1974), layout approval, adherence with MGN 543 (MCA, 2016), marine Coordination, production of a ERCoP and communication of information.	Minor adverse (mitigation considered embedded)
Operation						
Impact 1: Displacement	Commercial vessels, Windfarm support vessels, Oil and gas vessels, Aggregate dredgers, Fishing vessels, Recreational vessels	Frequent	Negligible	Moderate adverse	Communication of information, display information on charts, vessel traffic will be monitored, AtoN Management Plan.	Moderate adverse (additional mitigation required through continued consultation expected to reduce impacts to minor)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 2 - Collision risk	All vessel types	Remote	Serious	Moderate adverse	Coordination and communication of information, vessels will also adhere to COLREGS (IMO, 1972) and SOLAS (1974), vessel traffic and encounters will be monitored at the start of the operational period, operational procedures and AtoN Management Plan.	Moderate adverse (additional mitigation required through continued consultation)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 3 - Allision risk	All vessel types	Remote	Serious	Moderate adverse	Implementation of safety zones, adherence to layout rules and obtain layout approval, active communication of information, installation of lighting and marking and the use of guard vessels.	Moderate adverse (mitigation considered embedded)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 4 - Interaction with subsea cables	All vessel types	Extremely Unlikely	Moderate	Minor adverse	Communication of information, installation vessels compliant with COLREGS (IMO, 1972), RAM status displayed status, minimum safe passing distance of maintenance vessels, guard vessels where appropriate, temporary buoyage as required where cables are not yet protected or buried and baseline anchoring activity included within the Cable Burial Risk Assessment.	Minor adverse (mitigation considered embedded)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 5 - Under keel clearance	All vessel types	Extremely Unlikely	Moderate	Minor adverse	Consultation with the MCA and Trinity House in any instances where water depths are reduced by more than 5% as a result of cable protection to determine whether additional mitigation is necessary to ensure the safety of passing vessels.	Minor adverse (mitigation considered embedded)

Potential impact	Receptor	Frequency	Consequence	Pre-mitigation impact	Mitigation measures proposed	Residual impact
Impact 6 - Emergency response	All vessel types	Extremely Unlikely	Serious	Minor adverse	Adherence with COLREGS (IMO, 1972) and SOLAS (1974), layout approval, adherence with MGN 543 (MCA, 2016), marine Coordination, production of a ERCoP and communication of information.	Minor adverse (mitigation considered embedded)

15.13 References

Anatec (2020) Sheringham Shoal and Dudgeon Extension Projects Draft Navigation Risk Assessment for PEIR. A4523-EQ-NRA-1.
BMAPA (2009) Renewable Energy & Cables. Dredger transit routes (Online) Available from the British Marine Aggregate Producers Association (BMAPA) website: https://bmapa.org/issues/renewable_energy.php
PINS (2019). Scoping Opinion: Proposed Dudgeon and Sheringham Shoal Offshore Wind Farm Extensions. Planning Inspectorate Reference EN010109. Available at: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010109/EN010109-000006-EQNR_Scoping%20Opinion%202017%20EIA%20Regs.pdf
PINS (2018). Planning Inspectorate Advice Note Nine: Rochdale Envelope.
DECC. (2011) National Policy Statement for Renewable Energy Infrastructure (EN-3), London: DECC.
IALA. (2013) O-139 the Marking of Man-Made Offshore Structures, Edition 2. Saint Germain en Laye, France: IALA.
MCA (2013). Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI). Southampton: MCA.
MCA (2016). Marine Guidance Note 543 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response. Southampton: MCA.
IMO (2018). Revised Guidelines for Formal Safety Assessment (FSA) for Use in the Rule-Making Process. MSC-MEPCC.2/Circ.12/Rev.2. London: IMO.
IMO (1972). Convention on International Regulations for Preventing Collisions at Sea (COLREGs) – Annex 3. London: IMO.
IMO (1974). International Convention for the Safety of Life at Sea (SOLAS). London: IMO.
IALA (2013). International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation O-139 on The Marking of Man-Made Offshore Structures. Edition 2. Saint Germain en Laye, France: IALA.
MCA (2019). MCA ERCoP Template. Southampton: MCA.

MCA (2013). Methodology for Assessing the Marine Navigational Safety & Emergency Response Risks of Offshore Renewable Energy Installations (OREI). Southampton: MCA.

RYA (2019). The RYA's Position on Offshore Renewable Energy Developments: Paper 1 (of 4) – Wind Energy. 5th revision. Southampton: RYA.
DECC (2011a). Standard Marking Schedule for Offshore Installations. London: DECC.

RYA (2018). UK Coastal Atlas of Recreational Boating. 2nd Edition. Southampton: RYA.

Equinor (2019). Dudgeon Extension & Sheringham Shoal Extension, UK Metocean Summary, Doc Ref: MAD, CDEZ 11.10.2019, Metocean ME2019–144.