Hornsea Project Four:

Volume A2, Chapter 7: Shipping and Navigation

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Glossary

Term	Definition
Allision	The act of striking or collision of a moving vessel against a stationary object.
Automatic Identification System (AIS)	A system by which vessels automatically broadcast their identity, key statistics including location, destination, length, speed and current status, e.g., under power. Most commercial vessels and European Union (EU) fishing vessels over 15 metres (m) length are required to carry AIS.
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.
Commitment	A term used interchangeably with mitigation and enhancement measures. The purpose of Commitments is to reduce and/or eliminate Likely Significant Effects (LSEs), in Environmental Impact Assessment (EIA) terms. Primary (Design) or Tertiary (Inherent) are both embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, Preliminary Environmental Information Report (PEIR) or Environmental Statement (ES)). Secondary commitments are incorporated to reduce LSE to environmentally acceptable levels following initial assessment i.e. so that residual effects are acceptable.
Design Envelope	A description of the range of possible elements that make up the Hornsea Four design options under consideration, as set out in detail in **Volume A1, Chapter 4: Project Description**. This envelope is used to define Hornsea Four for EIA purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into United Kingdom (UK) law by the EIA Regulations.
Formal Safety Assessment (FSA)	A structured and systematic process for assessing the risks and costs (if applicable) associated with shipping activity.
Future Case	The assessment of risk based on the predicted growth in future shipping densities and traffic types as well as foreseeable changes in the marine environment.
Global Maritime Distress and Safety System (GMDSS) Sea Area	GMDSS sea areas serve two purposes: to describe areas where GMDSS services are available, and to define what radio equipment GMDSS ships must carry (carriage requirements).
Hornsea Project Four Offshore Wind Farm	The term covers all elements of the project (i.e. both the offshore and onshore). Hornsea Four infrastructure will include offshore generating stations (wind turbines), electrical export cables to landfall, and connection to the electricity transmission network. Hereafter referred to as Hornsea Four.
International Maritime Organization (IMO) Routeing	Predetermined shipping routes established by the IMO.
Layout Principles	A set of rules relating to the final array layout designed to ensure that post consent the array layout chosen for Hornsea Four satisfactorily meets both navigational and Search and Rescue (SAR) requirements (see **Volume A4, Annex 4.7: Layout Principles**).
Main Route	Defined transit route (mean position) of commercial vessels identified within the specified shipping and navigation study area.

Term	Definition
Marine Environmental High-Risk Area (MEHRA)	Areas in UK coastal waters where vessel masters are advised of the need to exercise more caution than usual i.e. crossing areas of high environmental sensitivity where there is a risk of pollution from commercial shipping.
Marine Guidance Note (MGN)	A system of guidance notes issued by the Maritime and Coastguard Agency (MCA) 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.
Maximum Design Scenario (MDS)	The maximum design parameters of each Hornsea Four asset (both on and offshore) considered to be a worst case for any given assessment.
Mitigation	A term used interchangeably with Commitment(s) by Hornsea Four. Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping, PEIR or ES).
Not Under Command (NUC)	Under Part A of the International Regulations for Preventing Collisions at Sea (COLREGS), the term "vessel not under command" means a vessel which through some exceptional circumstance is unable to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel.
Offshore Renewable Energy Infrastructure (OREI)	As defined by *Marine Guidance Note 654 (Merchant and Fishing) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response* (MCA 2021). For the purpose of this report and in keeping with the consistency of the EIA, OREI can mean offshore Wind Turbine Generators (WTG) and the associated electrical infrastructure such as offshore transformer substations, offshore High Voltage Direct Current (HVDC) converter substations, accommodation platforms and High Voltage Alternating Current (HVAC) booster stations.
Orsted Hornsea Project Four Ltd.	The Applicant for the proposed Hornsea Project Four Offshore Wind Farm Development Consent Order (DCO).
Radio Detection and Ranging (Radar)	An object-detection system which uses radio waves to determine the range, altitude, direction or speed of objects.
Regular Operator	Commercial operator whose vessel(s) are observed to transit through a particular region on a regular basis.
Safety Zone	A marine zone demarcated for the purposes of safety around a possibly hazardous installation or works/construction area under the Energy Act 2004.
Traffic Separation Scheme (TSS)	A traffic-management route-system ruled by the IMO. The traffic-lanes (or clearways) indicate the general direction of the vessels in that zone; vessels navigating within a TSS all sail in the same direction or they cross the lane in an angle as close to 90 degrees (°) as possible.
Unique Vessel	An individual vessel identified on any particular calendar day, irrespective of how many tracks were recorded for that vessel on that day. This prevents vessels being over counted. Individual vessels are identified using their Maritime Mobile Service Identity (MMSI).

Acronyms

Acronym	Definition
ABP	Associated British Ports
AfL	Agreement for Lease
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
BMAPA	British Marine Aggregate Producers Associations
CA	Cruising Association
CAA	Civil Aviation Authority
CD	Chart Datum
CEA	Cumulative Environmental Assessment
COLREGS	Convention for the Prevention of Collisions at Sea
CPA	Closest Point of Approach
DCO	Development Consent Order
DECC	Department for Environment and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DML	Deemed Marine Licence
EEA	European Economic Area
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
ERCoP	Emergency Response Cooperation Plan
ES	Environmental Statement
FSA	Formal Safety Assessment
GBS	Gravity Base Structure
GLA	General Lighthouse Authority
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
HRA	Helicopter Refuge Area
HSE	Health and Safety Executive
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IHO	International Hydrographic Organisation
IMO	International Maritime Organization
LOA	Length Overall
LSE	Likely Significant Effect
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MDS	Maximum Design Scenario
MEHRA	Marine Environmental High-Risk Area
Metocean	Meteorological Ocean
MGN	Marine Guidance Note
MHCC	Marine Helicopter Coordination Centre
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MMSI	Maritime Mobile Service Identity

Acronym	Definition
MOD	Ministry of Defence
NAVTEX	Navigational Telex
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NSA	Norwegian Shipowners' Association
NSIP	Nationally Significant Infrastructure Project
NUC	Not Under Command
OREI	Offshore Renewable Energy Installation
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Area
PINS	Planning Inspectorate
Radar	Radio Detection and Ranging
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institute
RYA	Royal Yachting Association
SAR	Search and Rescue
SNSOWF	Southern North Sea Offshore Wind Forum
SOLAS	Safety of Life at Sea Convention
SONAR	Sound Navigation Ranging
TCE	The Crown Estate
TSS	Traffic Separation Scheme
UK	United Kingdom
UKHO	United Kingdom Hydrographic Office
UKMPG	UK Major Ports Group
VHF	Very High Frequency
WTG	Wind Turbine Generator
ZAP	Zone Appraisal and Planning

Units

Unit	Definition
km	Kilometre
km^2	Square Kilometre
kt	Knot
m	Metre
nm	Nautical Mile

7.1 Introduction

7.1.1.1 Orsted Hornsea Project Four Limited (the 'Applicant') is proposing to develop the Hornsea Project Four Offshore Wind Farm (hereafter 'Hornsea Four') which will be located approximately 69 kilometres (km) from the East Riding of Yorkshire in the southern North Sea and will be the fourth project to be developed in the former Hornsea Zone (please see **Volume A1, Chapter 1: Introduction** for further details on the former Hornsea Zone). Hornsea Four will include both offshore and onshore infrastructure including an offshore generating station (wind farm), export cables to landfall, and connection to the electricity transmission network (please see **Volume A1, Chapter 4: Project Description** for full details on the Project Design).

7.1.1.2 The Hornsea Four Agreement for Lease (AfL) area was 846 square kilometres (km^2) at the Scoping phase of project development. In the spirit of keeping with Hornsea Four's approach to Proportionate Environmental Impact Assessment (EIA), the project has due consideration to the size and location (within the existing AfL area) of the final project that is being taken forward to Development Consent Order (DCO) application. This consideration is captured internally as the "Developable Area Process", which includes Physical, Biological and Human constraints in refining the developable area, balancing consenting and commercial considerations with technical feasibility for construction.

7.1.1.3 The combination of Hornsea Four's Proportionality in EIA and Developable Area process has resulted in a marked reduction in the AfL taken forward at the point of DCO application. Hornsea Four adopted a major site reduction from the AfL presented at Scoping (846 km^2) to the Preliminary Environmental Information Report (PEIR) boundary (600 km^2), with a further reduction adopted for the Environmental Statement (ES) and DCO application (468 km^2) due to the results of the PEIR, technical considerations and stakeholder feedback. The evolution of the AfL is detailed in **Volume A1, Chapter 3: Site Selection and Consideration of Alternatives** and **Volume A4, Annex 3.2: Selection and Refinement of the Offshore Infrastructure**.

7.1.1.4 This chapter of the ES presents the results of the EIA for the potential impacts of Hornsea Four on shipping and navigation. Specifically, this chapter considers the potential impact of Hornsea Four seaward of Mean High Water Springs (MHWS) during its construction, operation and maintenance, and decommissioning phases.

7.1.1.5 This chapter summarises information contained within **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.2 Purpose

7.2.1.1 The primary purpose of the ES is to support the DCO application for Hornsea Four under the Planning Act 2008 (the 2008 Act).

7.2.1.2 The ES has been finalised following completion of pre-application consultation (see **B1.1: Consultation Report** and **Table 7.4**) and the ES accompanies the application to the Planning Inspectorate (PINS) for Development Consent.

7.2.1.3 This ES chapter:

- Presents the existing environmental baseline in relation to shipping and navigation established from desk studies and consultation;
- Presents the potential environmental effects on shipping and navigation arising from Hornsea Four, based on the information gathered and the analysis and assessments undertaken;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible adverse environmental effects identified in the EIA process.

7.3 Planning and Policy Context

7.3.1.1 Planning policy on offshore renewable energy Nationally Significant Infrastructure Projects (NSIP), specifically in relation to shipping and navigation is contained in the National Policy Statement (NPS) for Renewable Energy Infrastructure (EN-3, Department for Environment and Climate Change (DECC) 2011).

7.3.1.2 Overarching NPS EN-1 does not specifically refer to shipping and navigation but the overarching guidance principles in general have been considered. NPS EN-3 includes guidance on what matters are to be considered in the assessment. These are summarised in **Table 7.1** below.

Table 7.1: Summary of NPS EN-3 policy provision relevant to shipping and navigation.

Summary of NPS EN-3 provisions	How and where considered in the ES
"*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.*" (paragraph 2.6.153 of NPS EN-3).	Engagement with navigation stakeholders has taken place from an early stage in the development of Hornsea Four. **Section 7.4** summarises key issues raised during consultation specific to shipping and navigation.
"*Assessment should be underpinned by consultation with the Marine Management Organisation (MMO), Maritime and Coastguard Agency (MCA), the relevant General Lighthouse Authority (GLA), 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.*" (paragraph 2.6.154 of NPS EN-3).	The consultation summarised in **Section 7.4** includes issues raised by the organisations stated.
"*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.*" (paragraph 2.6.155 of NPS EN-3).	**Section 7.7.2** provides information on International Maritime Organization (IMO) Routeing measures in proximity to Hornsea Four.
"*Applicants should undertake a Navigational Risk Assessment (NRA) in accordance with relevant Government guidance prepared in*	See **Volume A5, Annex 7.1: Navigational Risk Assessment**.

Summary of NPS EN-3 provisions	How and where considered in the ES
consultation with the MCA and the other navigation stakeholders listed above." (paragraph 2.6.156 of NPS EN-3).	
"*The potential effect on recreational craft, such as yachts, should be considered in any assessment.*" (paragraph 2.6.160 of NPS EN-3).	**Section 7.11** considers the impacts of Hornsea Four on all vessels, including recreational craft. Recreational activity including recreational fishing has also been considered in **Chapter 11: Infrastructure and Other Users**.

7.3.1.3 NPS EN-3 also highlights several factors relating to the determination of an application and in relation to mitigation. These are summarised in **Table 7.2** below.

Table 7.2: Summary of NPS EN-3 policy on decision making relevant shipping and navigation.

Summary of NPS EN-3 provisions	How and where considered in the ES
"*Consent shall not be granted to the construction or extension of an offshore wind farm if the development is likely to interfere with the use of recognised sea lanes essential to international navigation.*" (paragraph 2.6.161 of NPS EN-3).	**Section 7.7.2** provides information on IMO Routeing measures in proximity to Hornsea Four.
"*Site selection should have been made with a view to avoiding or minimising disruption or economic loss to the shipping and navigation industries.*" (paragraph 2.6.162 of NPS EN-3).	The impact of Hornsea Four, and cumulatively with other projects, plans and activities, are considered from **Section 7.12** and includes an analysis of the potential for disruption and economic loss to the shipping and navigation industries.
"*Negative impacts on less strategically important shipping routes should be reduced to As Low as Reasonably Practicable (ALARP).*" (paragraph 2.6.163 of NPS EN-3).	**Section 7.7.2** undertakes an analysis of all shipping including main routes in proximity to the Hornsea Four array area and High Voltage Alternating Current (HVAC) booster station search area. The impact assessment methodology in **Section 7.10** considers Formal Safety Assessment (FSA) and ALARP parameters.
"*A detailed Search and Rescue (SAR) Response Assessment should be undertaken prior to the commencement of construction.*" (paragraph 2.6.164 of NPS EN-3).	As part of Hornsea Four compliance with Marine Guidance Note (MGN) 654 (MCA 2021) an Emergency Response Cooperation Plan (ERCoP) will be developed for all phases, as noted in **Section 7.8.2**. It is noted post consent that Hornsea Four will be required to comply with MCA and Health and Safety Executive (HSE) regulatory expectations for emergency response arrangements for the offshore renewable energy industry (HSE 2019).
"*Applications which pose unacceptable risks to navigational safety after all possible mitigation measures have been considered will not be consented.*" (paragraph 2.6.165 of NPS EN-3).	The impact of Hornsea Four, including on a cumulative level, is assessed from **Section 7.11** and commitments included as part of Hornsea Four are summarised in **Section 7.8.2**.
"*The scheme must be designed to minimise the effects on recreational craft.*" (paragraph 2.6.166 of NPS EN-3).	**Section 7.8.2** summarises commitments included as part of Hornsea Four. Impact assessment for all vessels, including recreational vessels, is included in **Section 7.11**.
"*The extent and nature of any obstruction of or danger to navigation which is likely to be caused by the development will be considered.*" (paragraph 2.6.168 of NPS EN-3).	A technical assessment is included in **Volume A5, Annex 7.1: Navigational Risk Assessment** with impact assessment undertaken in **Section 7.11**.

Summary of NPS EN-3 provisions	How and where considered in the ES
"Cumulative effects of the development with other relevant proposed, consented and operational wind farms will be considered." (paragraph 2.6.169 of NPS EN-3).	Section 7.12 includes a Cumulative Effect Assessment (CEA) with transboundary and inter-related effects considered separately in Section 7.13 and Section 7.14, respectively.

7.3.1.4 The East Inshore and East Offshore Marine Plans (Department for Environment, Food and Rural Affairs (DEFRA) 2014) inform and guide regulation, management, use and protection of the marine plan areas, and include a section dedicated to ports and shipping. Table 7.3 summarises information within the plans which are relevant to shipping and navigation, noting that plan policy PS3 applies only to the Inshore Marine Plan Area (up to 12 nm offshore off the coastline between Flamborough Head and Felixstowe) and therefore applies only to the offshore ECC.

Table 7.3: Summary of East Inshore and East Offshore Marine Plans relevant to shipping and navigation.

Summary of East Inshore and East Offshore Marine Plans Provision	How and where Considered in the ES
"Proposals that require static sea surface infrastructure or that significantly reduce under-keel clearance should not be authorised in IMO designated routes." (plan policy PS1 of East Inshore and East Offshore Marine Plans)	Hornsea Four is not located within or in proximity to an IMO designated route as noted in Section 7.7.2.
"Proposals that require static sea surface infrastructure that encroaches upon important navigation routes should not be authorised unless there are exceptional circumstances. Proposals should: *a) be compatible with the need to maintain space for safe navigation, avoiding adverse economic impact;* *b) anticipate and provide for future safe navigational requirements where evidence and/or stakeholder input allows; and* c) *account for impacts upon navigation in-combination with other existing and proposed activities."* (plan policy PS2 of East Inshore and East Offshore Marine Plans)	An impact assessment relating to the safety of navigation is contained within Section 7.11. It is noted that there are no significant impacts relating to safety of navigation. Commercial impacts (with no navigational safety issues) are addressed in Section 7.13. A future case baseline (Section 7.7.4) has been modelled and assessed. This included consultation with key stakeholders (Section 7.4). In-combination impacts are considered within the CEA (Section 7.12).
"Proposals should demonstrate, in order of preference: *a) that they will not interfere with current activity and future opportunity for expansion of ports and harbours;* *b) how, if the proposal may interfere with current activity and future opportunities for expansion, they will minimise this;* *c) how, if the interference cannot be minimised, it will be mitigated; and* d) *the case for proceeding if it is not possible to minimise or mitigate the interference."* (plan policy PS3 of East Inshore and East Offshore Marine Plans)	Given the distance offshore, there is not considered to be any direct impact to ports and therefore the Applicant has engaged directly with potentially affected Regular Operators. A transboundary commercial effect in relation to the displacement of vessel routeing has been assessed and includes consideration of ports (Section 7.13).

7.4 Consultation

7.4.1.1 Consultation is a key part of the DCO application process. Consultation regarding shipping and navigation has been conducted through informal meetings with stakeholders, the EIA scoping process (Orsted 2018) and formal consultation on the PEIR. An overview of the project consultation process is presented within **Volume A1, Chapter 6: Consultation**.

7.4.1.2 A summary of the key issues raised during consultation specific to shipping and navigation is outlined below in **Table 7.4**, together with how these issues have been considered in the production of this ES.

7.4.1.3 Consultation with oil and gas operators is included within **Chapter 11: Infrastructure and Other Users**.

Table 7.4: Consultation responses.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
MCA	26 November 2018, Scoping Opinion	Summer season for vessel traffic survey should consider a period between June and August (inclusive) and winter season should consider a period between October and March (inclusive). With the seasonality considered the data can be up to 24 months old at the time of the submission of the ES.	The vessel traffic data used for the baseline navigation review includes data from June-August 2020 (summer) and February/March 2021 (winter). Further details of site-specific surveys are provided in **Section 7.6.2**.
		The development area carries a significant amount of through traffic, with a number of important shipping routes in close proximity, and attention needs to be paid to routeing, particularly in heavy weather ensuring shipping can continue to make safe passage without significant large-scale deviations.	Section 15.1 of **Volume A5, Annex 7.1: Navigational Risk Assessment** identified that there are 14 main routes operating within the Hornsea Four array area shipping and navigation study area. The busiest routes consist of two transits per day and when considered against other routeing within the southern North Sea are considered moderate use. Although some routes will require deviation these would not create a significant impact on navigational safety. This is considered within the impact assessment in **Section 7.11**.
		The proximity of Hornsea Four to other offshore wind farms will also need to be fully considered, with an appropriate assessment of the distances between Offshore Renewable Energy Installation (OREI) boundaries and shipping	Hornsea Four commitments (**Section 7.8.2**) include consideration of MGN 654 and adherence with lighting and marking requirements.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		routes as per MGN 543 [now superseded by MGN 654]. MCA would also welcome early discussion on the lighting and marking arrangements.	
MCA and Trinity House	27 November 2018, consultation meeting	Discussion on scoping responses and a review of the proposed developable areas.	No further action required.
DFDS Seaways	2 April 2019, consultation meeting	DFDS Seaways vessels on the Immingham-Esbjerg and Immingham-Gothenburg routes would deviate north of the Hornsea Four array area. A deviation of around 2 nautical miles (nm) west of the Hornsea Four array area for the Newcastle-Amsterdam route would not be a concern. The *Finlandia Seaways* and *Jutlandia Seaways* transits shown [from the winter 2019 vessel traffic survey data] are likely adverse weather routes and the *Lysvik Seaways* is about to switch to a new west coast route. No new routes are planned in the area.	Route deviations for the post wind farm scenario have accounted for the information provided (see Section 7.7.4), noting that since the consultation on 2 April 2019, a gap between Hornsea Four and Hornsea Project Two has been adopted through a change to the Hornsea Four Order Limits and DFDS Seaways have provided updated commentary on route deviations accordingly.
		No DFDS Seaways vessels intend to pass through Hornsea Project One where construction is ongoing and no concerns have been raised. Even with a large spacing between structures DFDS Seaways vessels would not transit through the array.	Route deviations for the post wind farm scenario have accounted for the information provided (see Section 7.7.4).
		Cumulatively the Dogger Bank developments will need to be considered as they prevent routeing across the Dogger Bank.	The Dogger Bank developments have been considered in the CEA (see Section 7.12), noting that Dogger Bank C was not screened in given its distance from Hornsea Four.
MCA and Trinity House	23 May 2019, consultation meeting	Discussion on proportionate approach to be used on the Hornsea Four application. The MCA noted that they would still expect to see all requirements listed under MGN 543 [now superseded by MGN 654].	Volume A5, Annex 7.1: Navigational Risk Assessment has followed the standard approach and is compliant with MGN 654 including completion of the MGN 654 Checklist (Appendix C).

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		Proposed marine traffic survey methodology was discussed.	Details of site-specific surveys are provided in Section 7.6.2.
		Layout principles were discussed, and a review process would be undertaken to seek agreement between Hornsea Four and the MCA/Trinity House.	Hornsea Four commitments include to seek agreement with the MCA and Trinity House on the Layout Principles (see Table 7.10) (Commitment Co96).
First Hazard Workshop including oil and gas operators, regular vessel operator, MCA, Trinity House, and UK Chamber of Shipping. Fisheries and recreational representatives were invited but did not attend.	27 June 2019, first Hazard Workshop	Discussion on the potential impacts identified for Hornsea Four array area, offshore ECC and HVAC booster station search area. Impacts identified were deviations (commercial), increased encounters and collision risk, allision risk, anchor snagging (limited risk), emergency response capability and impacts on other installations associated with displaced traffic. Impacts on other installations are considered in Chapter 11: Infrastructure and Other Users.	A hazard log was created to formalise the outputs of the Hazard Workshop (see Appendix B of Volume A5, Annex 7.1: Navigational Risk Assessment). This was then updated following a second Hazard Workshop (see 28 May 2020 entry in Table 7.4) and reviewed following a further change to the Hornsea Four array area. The hazard log has been used as input to the impact assessment (see Section 7.11).
VISNED	16 July 2019, consultation meeting	Entering the array, whether to fish or transit, is based on the individual skipper's perception of risk. Fishermen are likely to follow the features of the seabed, and if not available, then follow any rows of Wind Turbine Generators (WTGs).	The array layout includes a single line of orientation (see Section 9.1 of Volume A5, Annex 7.1: Navigational Risk Assessment). Hornsea Four commitments (see Section 7.8) include agreement with the MCA and Trinity House on the Layout Principles, which include maintaining at least one line of orientation in the array layout.
Associated British Ports (ABP)	20 September 2019, Section 42 response	The same issues of re-routeing which affect DFDS Seaways exist for other shipping lines accessing Scandinavia, Denmark, the Baltic Sea and Russia.	Regular Operator consultation has been undertaken with limited response from operators (see Section 14 of Volume A5, Annex 7.1: Navigational Risk Assessment).
		Concerned over the degree to which the commercial impact has been assessed although recognise the commitment to consult further on this matter.	Route deviations have been considered (see Section 7.7) and scoped into the impact assessment as a commercial issue (see Section 7.13). Extensive and constructive consultation with DFDS Seaways has been undertaken (see various entries in Table 7.4) to ensure commercial concerns are fully considered.
MCA		The FSA methodology must be used as a template for preparing	The proportionate approach to EIA aims to ensure assessments are

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
	23 September 2019, Section 42 response	the NRA and reassurance is needed that the proportionate approach undertaken by the Applicant still ensures all MCA requirements are addressed as appropriate in line with MGN 543 [now superseded by MGN 654].	focused and accessible to all stakeholders (see **Volume A1, Chapter 5: Environmental Impact Assessment Methodology**). It is noted that some elements of the assessment which were incomplete at PEIR have now been completed, such as the hazard log and MGN 654 Checklist, thus ensuring the FSA methodology is followed and the requirements of MGN 654 are satisfied.
		Radar [Radio Detection And Ranging] observations were not completed for the summer period at PEIR and therefore it cannot be confirmed that the NRA gives a true reflection of the current vessel traffic operating in and around the Hornsea Four array area.	Vessel traffic survey data for the summer 2019 period has been collected. However, following a change to the DCO application timing, new vessel traffic surveys (including Radar data) were undertaken to ensure compliance with the requirements of MGN 654. The vessel traffic data for the winter 2021 period is presented in **Section 7.7** and for the summer 2021 period is presented within the NRA as a validation exercise (see Appendix F of **Volume A5, Annex 7.1: Navigational Risk Assessment**).
		An MGN 543 Checklist [now superseded by the MGN 654 Checklist] was not provided at PEIR and an early opportunity to comment on a draft version to ensure all aspects have been adequately addressed would be welcomed.	An MGN 654 Checklist has been completed (see Appendix C of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and a draft NRA was provided to the MCA for review prior to the DCO application.
		Given the prominence of commercial vessels in the vessel traffic survey data further consultation should be undertaken with those affected by routeing, particularly in heavy weather ensuring shipping can continue to make safe passage.	Regular Operator consultation has been undertaken (see Section 14 of **Volume A5, Annex 7.1: Navigational Risk Assessment**). Adverse weather routeing and the potential for navigational risk has been considered (see **Section 7.11**).
		It is unclear whether an FSA has been undertaken, although the approach of reassessment of impacts following discussion with	Due to time constraints the hazard log was omitted from the NRA submitted at PEIR and therefore no FSA was included in the PEIR. A

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		local stakeholders regarding possible mitigation is welcomed, noting that a helicopter refuge area (HRA) may be a possible mitigation.	hazard log has now been undertaken (see Appendix B of **Volume A5, Annex 7.1: Navigational Risk Assessment**). The need for defined HRAs has been considered in consultation with the MCA and forms part of the Layout Principles (see **Volume A4, Annex 4.7: Layout Principles**).
		The inclusion of a single line of orientation in the layout and continuation of layout design from Hornsea Project One and Hornsea Project Two will require further discussion. Additionally, for the single line of orientation a detailed safety justification will be required for both surface navigation and SAR capability.	As per the Layout Principles (see **Volume A4, Annex 4.7: Layout Principles**) a safety justification has been developed and consulted on with the MCA (see **Volume A4, Annex 4.9: Safety Justification for Single Line of Orientation Layout**).
		The Layout Principles remain under discussion between the Applicant and the MCA and should not replace the MCA approval process for the layout.	The Layout Principles have been devised in consultation with the MCA and when used within conditions DCO Schedule 11, Part 2 - Condition 13(1)(a) and DCO Schedule 12, Part 2 - Condition 13(1)(a) will give allowance for the MCA to give approval of the layout post-consent (see **Volume A4, Annex 4.7: Layout Principles**).
		Hydrographic surveys should fulfil the requirements of the International Hydrographic Organisation (IHO) Order 1a standard with the final data supplied, ideally at the ES stage.	Hydrographic survey data will satisfy the IHO requirements and be supplied prior to the start of construction, as per the project commitments (see **Volume A4, Annex 5.2: Commitments Register**) and as per email agreement with the MCA (2 April 2020)
		Due cognisance needs to address cable burial and protection, particularly close to shore where impacts on navigable water depth may become significant. A maximum 5% reduction in surrounding water depth referenced to Chart Datum (CD) is acceptable.	The need to adhere to MGN 654 with respect to reductions in under keel clearance by greater than 5% is considered a project commitment (see **Section 7.8**).
		Safety Zones during all phases are supported, however it should be	Safety Zones of 500 m around construction and major maintenance

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		noted that operational Safety Zones may have a maximum 50 metre (m) radius from the individual turbines.	works will be applied for and is considered a project commitment (see Section 7.8.2).
		A SAR Checklist must be discussed with the MCA as the project progresses and an ERCoP will be required prior to construction.	Hornsea Four commitments (Section 7.8.2) include consideration of MGN 654 which includes the expectation that a SAR Checklist will be completed and the creation of an ERCoP.
Trinity House	23 September 2019, Section 42 response	A joint meeting with the MCA to discuss the NRA and its accordance with MGN 543 [now superseded by MGN 654] would be welcomed.	A consultation meeting with the MCA and Trinity House was undertaken post PEIR (see 25 November 2019 entry in Table 7.4) and both MCA and Trinity House were provided a draft version of the NRA for comment prior to the DCO application.
		Preference would be for structures to be positioned creating multiple lines of orientation and at the very least continue the single line of orientation with Hornsea Project One and Hornsea Project Two (on adjacent boundaries).	As per the Layout Principles (see Volume A4, Annex 4.7: Layout Principles) a safety justification has been developed and consulted on with the MCA should a Single Line of Orientation be taken forward (see Volume A4, Annex 4.9: Safety Justification for Single Line of Orientation Layout).
DFDS Seaways	23 September 2019, Section 42 response	Any increase to crossing times will make it difficult to maintain schedules at the port of Immingham, where berth numbers are limited. Any delay in the service provided will be unattractive to customers who operate their own schedules.	Route deviations have been considered (see Section 7.7) and scoped into the impact assessment as a commercial issue (see Section 7.13).
		Any deviation from the current routes will incur a financial cost with any increase in speed to minimise disruption resulting in additional fuel requirements which will incur further financial cost.	Route deviations have been considered (see Section 7.7) and scoped into the impact assessment as a commercial issue (see Section 7.13).
		Delays to existing ferry services will result in Humberside being seen as a less attractive option for Scandinavian freight.	Route deviations (resulting in delayed services) have been considered (see Section 7.7) and scoped into the impact assessment as a commercial issue (see Section 7.13).
		The suggested displacement of routes heading north towards the	Route deviations have been considered (see Section 7.7) and

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		Dogger Bank is of concern given the dangerous navigation conditions present there, particularly in adverse weather.	scoped into the impact assessment as a navigational safety issue, particularly with regard to adverse weather conditions (see Section 7.11). It is noted that the change to the Hornsea Four Order Limits to incorporate a gap between Hornsea Four and Hornsea Project Two minimises interaction with the Dogger Bank.
		Without evidence of a feasibility study on the subject, a navigation corridor, in compliance with MGN 543 [now superseded by MGN 654], is considered an appropriate form of mitigation for the commercial issues relating to vessel routeing.	The layout assessed in the ES (see Section 7.9) considers a full build out but of a reduced array area (from that presented at PEIR) following a change to the Hornsea Four Order Limits to incorporate a gap between Hornsea Four and Hornsea Project Two. Extensive and constructive consultation including with the primary affected party, DFDS Seaways, has been undertaken to ensure commercial concerns are fully considered.
UK Chamber of Shipping	23 September 2019, Section 42 response	Consultation with the UK Chamber of Shipping was relatively late in commencing and DFDS Seaways was not consulted with in person until April 2019.	The Applicant engaged all statutory consultees during the scoping process as required. Only once site specific vessel traffic survey data was collected and analysed could identified Regular Operators, including DFDS Seaways, be contacted to participate in consultation (see 2 April 2019 entry in Table 7.4). The UK Chamber of Shipping was invited (and attended) both Hazard Workshops (see 27 June 2019 and 28 May 2020 entries in Table 7.4) and was consulted by SMartWind during the zonal stage for the Former Hornsea Zone including the Southern North Sea Offshore Wind Forum (SNSOWF).
		There are other Regular Operators besides DFDS Seaways facing similar navigational risk challenges due to Hornsea Four which should be consulted.	Regular Operator consultation has been undertaken with limited response from other operators (see Section 14 of Volume A5, Annex 7.1: Navigational Risk Assessment).

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		Deviation of routes northwards towards the Dogger Bank may lead to increased risk to navigational safety, especially in adverse weather.	Route deviations have been considered (see Section 7.7) and scoped into the impact assessment as a navigational safety issue, particularly with regard to adverse weather conditions (see Section 7.11). It is noted that the change to the Hornsea Four Order Limits to incorporate a gap between Hornsea Four and Hornsea Project Two minimises interaction with the Dogger Bank.
		The inclusion of a single line of orientation in the layout is a concern and it should be ensured that the MCA and Trinity House are content with the safety justification.	As per the Layout Principles (see Volume A4, Annex 4.7: Layout Principles) a safety justification has been developed and consulted on with the MCA should a Single Line of Orientation be taken forward (see Volume A4, Annex 4.9: Safety Justification for Single Line of Orientation Layout). This safety justification may be submitted at any point of the application or post consent process.
		With Hornsea Four lying within part of the former Hornsea Zone, the preceding three developments is a large area which shall no longer be safe sea room for larger commercial vessels. Consideration of the cumulative changes to routeing within 10 nm of the Hornsea Four array area is inadequate for assessing the wider impact on shipping and navigation. Additionally, ports cannot be considered as part of the baseline since commercial port operations may be negatively impacted due to the diminished viability of merchant shipping routes.	Hornsea Project One and Hornsea Project Two are considered as part of the baseline assessment and Hornsea Three has been screened into the CEA as a Tier 1 development (see Section 19 of Volume A5, Annex 7.1: Navigational Risk Assessment) and therefore quantitative cumulative re-routeing of main routes with consideration of all the Hornsea developments has been undertaken as part of the CEA (see Section 7.12). Such assessment has been undertaken within 10 nm of all the Hornsea developments. Given the distance offshore, there is not considered to be any direct impact to ports and therefore the Applicant has engaged directly with potentially affected Regular Operators.
		Without evidence of a feasibility study on the subject, a navigation corridor, in compliance with	The layout assessed in the ES (see Section 7.9) considers a full build out but of a reduced array area (from that

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		MGN 543 [now superseded by MGN 654], is considered an appropriate form of mitigation for the commercial issues relating to vessel routeing.	presented at PEIR) following a change to the Hornsea Four Order Limits to incorporate a gap between Hornsea Four and Hornsea Project Two. Extensive and constructive consultation including with the primary affected party, DFDS Seaways, has been undertaken to ensure commercial concerns are fully considered.
Danish Shipping and Norwegian Shipowners' Association (NSA)	23 September 2019, Section 42 responses	Given the navigational safety risks associated with navigating in adverse weather conditions and in proximity to offshore wind farms the establishment of a navigation corridor compliant with MGN 543 [now superseded by MGN 654] is recommended.	The layout assessed in the ES (see **Section 7.9**) considers a full build out but of a reduced array area (from that presented at PEIR) following a change to the Hornsea Four Order Limits to incorporate a gap between Hornsea Four and Hornsea Project Two.
		The proposed deviation to shipping routes will have a significant negative effect on the commercial viability of DFDS Seaways and other operators given the difficulty maintaining published schedules on services and increased fuel consumption.	The commercial impact of Hornsea Four on routeing has been considered as a transboundary effect (see **Section 7.13**).
UK Major Ports Group (UKMPG)	25 September 2019, Section 42 response	Disappointed to hear reports that the process of engagement with shipping lines has been inadequate.	The Applicant engaged all statutory consultees during the scoping process as required. Only once site specific vessel traffic survey data was collected and analysed could identified Regular Operators be contacted to participate in consultation (see Section 14 of **Volume A5, Annex 7.1: Navigational Risk Assessment**).
		There should be adequate regard to the cumulative consequences and the impact of ports and shipping should not be dismissed as part of a baseline.	A CEA has been undertaken (see **Section 7.12**). Given the distance offshore, there is not considered to be any direct impact to ports and therefore the Applicant has engaged directly with potentially affected Regular Operators.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
DFDS Seaways	5 November 2019, consultation meeting	Agreed with vessel traffic survey data findings that there are four routes of note featuring DFDS Seaways vessels in proximity to Hornsea Four: • Immingham to Esbjerg. • Immingham to Gothenburg. • North Shields to Ijmuiden; and • Immingham to Oslo.	All of the routes noted have been considered as part of the baseline (see Section 7.7).
		Inclusion of a navigation corridor can deal with the re-routeing concerns and is DFDS Seaways' preferred method for mitigating the commercial impact.	The layout assessed in the ES (see Section 7.9) considers a full build but of a reduced array area (from that presented at PEIR) following a change to the Hornsea Four Order Limits to incorporate a gap between Hornsea Four and Hornsea Project Two.
Danish Shipping	7 November 2019, consultation meeting	Consultation between the Applicant and DFDS Seaways is the most vital going forward.	Extensive and constructive consultation including with the primary affected party, DFDS Seaways, has been undertaken to ensure commercial concerns are fully considered.
Sea-Cargo	12 November 2019, email correspondence	The Immingham-Tanager route used by Sea-Cargo would not be affected. The Immingham-Esbjerg route would be affected and require a deviation with north and south alternatives suggested, noting that vessels would not consider making passage internally through the array.	Route deviations for the post wind farm scenario have accounted for the information provided (see Section 7.7.4).
		Offshore developments can affect adverse weather transits with the available sea space and suitable courses limited when fighting against the sea.	Adverse weather routeing and the potential for navigational risk has been considered (see Section 7.11).
ABP	20 November 2019, consultation meeting	Queried whether any consultation has been undertaken with Finnlines.	Finnlines were contacted to participate in consultation (see Section 14 of Volume A5, Annex 7.1: Navigational Risk Assessment) but did not provide a response.
MCA and Trinity House	25 November 2019, consultation meeting	Queried level of fishing stakeholder consultation.	Fishing consultation has been primarily undertaken in conjunction within the commercial fisheries chapter of the ES (see Chapter 6: Commercial Fisheries) but fishing stakeholders were approached and

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
			invited to participate in consultation for shipping and navigation.
		The MCA can only comment on matters relating to navigational safety but will keep abreast of the issues.	No response required.
		Safety risks would need to be considered for any navigation corridor.	A safety case has been undertaken for the gap between Hornsea Four and Hornsea Project Two (see Section 19.3 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) noting that the gap is not strictly considered a navigation corridor given its non-parallelogram shape.
		There is a strong preference to discontinue the layout set by Hornsea Project One and Hornsea Project Two possibly by use of an HRA.	The array layout includes a single line of orientation (see Section 9.1 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) which is aligned with Hornsea Project One and Hornsea Project Two. As per the Layout Principles (see **Volume A4, Annex 4.7: Layout Principles**) a safety justification has been developed and consulted on with the MCA (see **Volume A4, Annex 4.9: Safety Justification for Single Line of Orientation Layout**).
UKMPG	27 November 2019, consultation meeting	Queried how the commercial impact on routeing would be dealt with.	The commercial impact of Hornsea Four on routeing has been considered as a transboundary effect (see **Section 7.13**).
Second Hazard Workshop including oil and gas operators, regular vessel operator, MCA, Trinity House, and UK Chamber of Shipping. Fisheries, recreational and Viking Link representatives were invited but did not attend.	28 May 2020, second Hazard Workshop	Discussion on the potential impacts identified for the Hornsea Four array area, offshore ECC and HVAC booster station search area, with particular emphasis on the gap between Hornsea Four and Hornsea Project Two (which was not under consideration by the Applicant at the time of the first Hazard Workshop). The proposed wording of the commercial impact was agreed and following the Hazard Workshop multiple consultees expressed satisfaction with the design of the gap (see entries below). Impacts on other	The hazard log was updated to reflect the outputs of the second Hazard Workshop (see Appendix B of **Volume A5, Annex 7.1: Navigational Risk Assessment** and has been used as input to the impact assessment (see **Section 7.11**).

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		installations are considered in Chapter 11: infrastructure and Other Users.	
Trinity House	3 June 2020, email correspondence	The exclusion of blade overfly from the measured gap between Hornsea Four and Hornsea Project Two was considered not acceptable at the time of review (June 2020). Trinity House suggested that any references to distances were solely around the proposed distances created by the gap.	Since this correspondence, and in response to this concern, the way the gap is referenced has been clarified. The gap has now been adopted as a change to the Hornsea Four Order Limits and distance reference points are clearly stated where included (typically between WTGs centre-to-centre).
UK Chamber of Shipping	5 June 2020, email correspondence	Strongly support the inclusion of a gap between Hornsea Four and Hornsea Project Two, noting that adverse anticipated future case routeing shown for regular routes are removed or minimised.	Noted and taken into consideration in the assessment of the commercial impact of Hornsea Four on routeing (see Section 7.13).
ABP	5 June 2020, email correspondence	The proposed gap between Hornsea Four and Hornsea Project Two seems to be a very sensible and welcome solution and should greatly assist merchant shipping stakeholders.	Noted and taken into consideration in the assessment of the commercial impact of Hornsea Four on routeing (see Section 7.13).
Cruising Association (CA)	8 June 2020, email correspondence	The gap between Hornsea Four and Hornsea Project Two both provides an alternative wider corridor through the site and funnels larger vessels into the gap allowing skippers of smaller vessels to choose the wider channel or go through the array knowing that they are unlikely to meet very large craft. The CA support the proposed gap.	Noted and taken into consideration in the assessment of the commercial impact of Hornsea Four on routeing (see Section 7.13).
DFDS Seaways	8 June 2020, email correspondence	Assuming that the gap between Hornsea Four and Hornsea Project Two would have no size restrictions for the users above and beyond those related to water depth, this solution would allow DFDS Seaways operated vessels to pass through and thereby enable the maintaining of the current routes for Scandinavia to Immingham.	Noted and taken into consideration in the assessment of the commercial impact of Hornsea Four on routeing (see Section 7.13).

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
Danish Shipping	11 June 2020, email correspondence	Fully support the implementation of a gap between Hornsea Four and Hornsea Project Two with a minimum width of 2.2 nm.	Noted and taken into consideration in the assessment of the commercial impact of Hornsea Four on routeing (see Section 7.13).
MCA and Trinity House	17 June 2020, consultation meeting	Questioned the set back of structures from the Hornsea Project Two boundary and the potential for ancillary equipment (e.g. jack-ups) to be placed at the periphery structures, therefore reducing the navigable gap width.	Any temporary installation would be manageable with mitigation including the use of a guard vessel if deemed necessary through risk assessment (see Section 7.8).
DFDS Seaways	17 July 2020, email correspondence	The anticipated deviations of DFDS Seaways' routes between Scandinavia and Immingham presented are reflective with only a 1 nm increase in the route length expected. This includes the Immingham to Oslo route which will follow the same course as the Immingham to Gothenburg route.	Outputs of consultation have been taken into consideration when defining the main route deviations post wind farm (see Section 7.7).
		Following the start of construction of Hornsea Project Two, DFDS Seaways' route between North Shields and Ijmuiden now passes further south to avoid the platforms in the Ravenspurn gas field.	Outputs of consultation have been taken into consideration when defining the main route deviations post wind farm (see Section 7.7) noting that the route alteration described is reflected in the 2020/21 vessel traffic data (see Section 7.7).
MCA	31 July 2020, email correspondence	The MCA expect the following to be undertaken as part of the consenting process as a result of the inclusion of the gap between Hornsea Four and Hornsea Project Two:	The hazard log was updated to reflect the outputs of the second Hazard Workshop (see Appendix B of Volume A5, Annex 7.1: Navigational Risk Assessment and has been used as input to an updated impact assessment (see Section 7.11). The gap has now been adopted as a change to the Hornsea Four Order Limits and distance reference points are clearly stated where included. Meteorological and oceanographic statistics local to Hornsea Four have been used as input to the collision and allision risk modelling and as input to the impact assessment (see Section 11 of Volume A5, Annex 7.1: Navigational Risk Assessment).

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		• The hazard log and risk controls to be updated with the gap and agreed by the Hazard Workshop attendees; • A new NRA submitted as part of the consent application incorporating the gap and a reassessment of risks and proposed mitigation; • The minimum distance at the narrowest point of the gap (which is in practice less than 2.2 nm) is known and accepted by those affected; and • The meteorological ocean (Metocean) conditions, ambient and any significant seasonal variations are considered as part of the reassessment.	
Viking Link Interconnector (National Grid and Energinet)	3 December 2020, consultation meeting	The inclusion of the gap between Hornsea Four and Hornsea Project Two increases the exposure of the Viking Link Interconnector for approximately 15 km. This leads to concerns in relation to: • Collision risk; • Anchor snagging risk; and • Electromagnetic fields (EMF) and compass deviations.	A safety case has been undertaken for the gap between Hornsea Four and Hornsea Project Two (see Section 19.3 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and includes commentary on the concerns raised. It is noted that the safety case includes the output of extensive consultation with relevant stakeholders with strong positive support for the gap indicated.
MCA and Trinity House	1 April 2021, consultation meeting	The proposed change to the north western extent of the Hornsea Four array area would represent a reduction in risk and therefore there is no clear reason to undertake a further Hazard Workshop.	Noted.
		A further meeting is suggested to discuss the approach to collection of summer 2021 vessel traffic data with AIS data required as a minimum.	The Applicant provided an outline of the methodology for the summer vessel traffic surveys to the MCA in May 2021 with no concerns raised by the MCA (Orsted Hornsea Project Four Limited 2021). A further meeting with the MCA was held in August 2021 to show the vessel traffic survey data (including the recently collected summer period) and further confirm

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
			the acceptability of the methodology.
Viking Link Interconnector (National Grid and Energinet)	7 April 2021, letter correspondence	The impact on the Viking Link Interconnector requires assessment as part of the EIA in accordance with EIA Regulations.	The Viking Link Interconnector has been considered a CEA development throughout the ES (see **Section 7.12**). Additionally, a safety case has been undertaken for the gap between Hornsea Four and Hornsea Project Two (including the Viking Link Interconnector) (see Section 19.3 of **Volume A5, Annex 7.1: Navigational Risk Assessment**)
		Request sight of the NRA and other ES sections where the Viking Link Interconnector is referred to.	Viking Link Interconnector will be provided the ES (including the NRA) when the DCO application is submitted and will be able to comment as part of the consultation on the application and thereafter during the examination process.
		Possible mitigation measures which would provide some protection for the Viking Link Interconnector include: • Move the gap; • Cover the exposed 15 km of the cable with rock berm; or • Introduce some form of traffic routeing measure, e.g. Traffic Separation Scheme (TSS) or precautionary area.	A safety case has been undertaken for the gap between Hornsea Four and Hornsea Project Two (see Section 19.3 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and includes commentary on the mitigation measures proposed. It is noted that the safety case includes the output of extensive consultation with relevant stakeholders with strong positive support for the gap indicated. With the gap in place the impact assessment (see **Section 7.11**) has found that all scoped impacts are not significant in EIA terms and therefore the mitigation already proposed (see **Section 7.8**) is considered appropriate.
MCA	7 June 2022 Consultation Meeting	Paragraph 7.11.2.42 of APP-019 – we recognise that larger commercial vessels are less likely to plan their passage through the array, however it must also be recognised that vessels may be required to navigate within an array due to unexpected circumstances.	Noted - APP-019 has considered both external and internal navigation within the array.

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
		Paragraph 7.11.2.44 of APP-019 – multiple lines of orientation and grid layouts provide more options for safe internal navigation and SAR access. Fishing vessels may follow seabed features when actively fishing however when transiting through a wind farm we would expect the turbine positions and alignment to have more of an influence on safe navigation	Noted – the Applicant is committed to working with the MCA on layouts noting within the Commitments adopted by Hornsea Four (mitigations) the Applicant has committed to ensuring compliance with Marine Guidance Note (MGN) 654.
		Paragraph 7.11.1.37 of APP-019 - it mentions there have been construction vessel allisions at low speed, however we note the Island Panther allided with Sheringham Shoal offshore wind farm at 12kts which would not be considered a slow speed.	Noted – Whilst the vessel is not referenced by name the Navigation Risk Assessment [APP-081] does note the incident which occurred on the 21st November 2012 – a work boat allided with an unlit transition piece of a wind turbine generator at a moderate speed.
		Paragraphs 7.11.1.61 to 7.11.1.64 of APP-019 –the increased presence of industry resources and the benefits they can bring to third party SAR and in responding to their own resources is recognised, however there is still an increase workload to SAR both through coordination and on the resources, hence MCA's need for access to AIS and VHF capability to HM Coastguard. For example, between 2020 and 2022 at Hornsea 1 and Hornsea 2 offshore wind farms, there were 13 recorded medical incidents (6 required a SAR helicopter), a minor environmental spill and an AIS alert for a man overboard that resulted in an extensive investigation but was a false alarm.	Noted – the Applicant is committed to working with the MCA post consent noting within the Commitments adopted by Hornsea Four (mitigations) the Applicant has committed to ensuring compliance with MGN 654. This will include consideration of access to Very High Frequency (VHF) and Automatic Identification System (AIS) equipment noting the potential for technical and cost constraints which may restrict this.
		Paragraph 7.11.2.64 of APP-019 - it is important to recognise that while Hornsea 4 will have self-help capability, this does not preclude the need for SAR support in the event of an incident.	Noted – the Applicant is committed to working with the MCA post consent noting within the Commitments adopted by Hornsea Four (mitigations) the Applicant has committed to ensuring compliance with MGN 654 which includes

Consultee	Date, Document, Forum	Issues raised	Response to issue and where addressed in the ES
			completion of a Search and Rescue Checklist.

7.5 Study area

7.5.1 Hornsea Four array area shipping and navigation study area

7.5.1.1 A minimum 10 nm buffer has been applied around the Hornsea Four array area, as shown in Figure 7.1. This shipping and navigation study area has been defined in order to provide local context to the analysis of risks by capturing the relevant routes and vessel traffic movements within and in proximity to the proposed Hornsea Four array area. A 10 nm shipping and navigation study area has been used within the majority of United Kingdom (UK) offshore wind farm NRAs including those for the previous Hornsea wind farm developments and has been agreed with the MCA and Trinity House during consultation meetings (see Section 7.4).

7.5.2 Hornsea Four offshore ECC shipping and navigation study area

7.5.2.1 A minimum 2 nm buffer has been applied around the Hornsea Four offshore ECC, as shown in Figure 7.1. As with the Hornsea Four array area, this study area has been defined in order to capture relevant receptors and their movements within and near the Hornsea Four offshore ECC. The study area runs between the Mean Low Water Springs (MLWS) and the boundary of the Hornsea Four array area and reflects the standard approach taken across the offshore wind industry and agreements with regulators.

7.5.3 Hornsea Four HVAC booster station search area shipping and navigation study area

7.5.3.1 A 10 nm buffer has been applied around the Hornsea Four HVAC booster station search area within the Hornsea Four offshore ECC, as shown in Figure 7.1. Again, this study area has been defined in order to capture relevant receptors and their movements within and near the Hornsea Four HVAC booster station search area. This study area reflects the standard approach taken across the offshore wind industry.

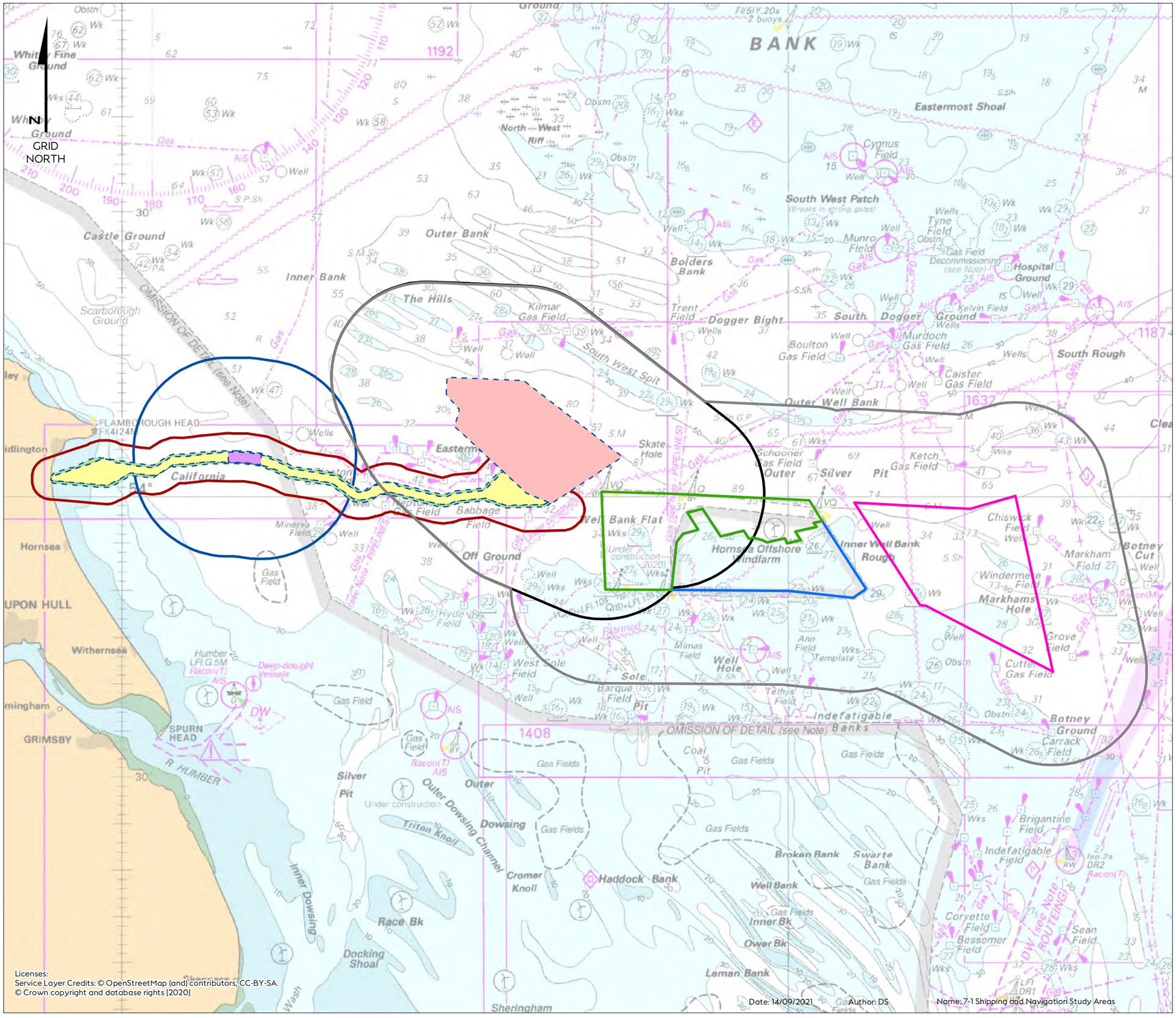
7.5.4 Hornsea Four cumulative shipping and navigation study area

7.5.4.1 Changes to routeing at a cumulative level have been assessed in detail within a minimum 10 nm buffer of the array area for each of the four Hornsea wind farm developments, as shown in Figure 7.1. Details of the methodology used to identify cumulative receptors are given in Section 7.12, noting that this extends well beyond the Hornsea Four cumulative shipping and navigation study area. This study area reflects the standard approach taken across the offshore wind industry.

Hornsea Four

Figure 7.1

Shipping and Navigation study areas



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Date: 14/09/2021 Author: DS Name: 7-1 Shipping and Navigation Study Areas

Hornsea Four Boundaries

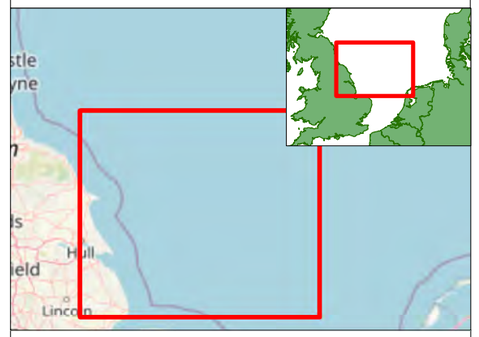
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Offshore Temporary Works Area

Other Hornsea Developments

- Hornsea Project One
- Hornsea Project Two
- Hornsea Three

Shipping and Navigation Study Areas

- Array Area Shipping and Navigation Study Area
- HVAC Booster Station Search Area Shipping and Navigation Study Area
- Offshore Export Cable Corridor Shipping and Navigation Study Area
- Cumulative Shipping and Navigation Study Area



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:1,250,000

0 25 50 Kilometres

0 5 10 20 Nautical Miles

REV	REMARK	DATE
	First Issue for PEIR	24/07/2019
A	Updated following PEIR consultations, for DCO	11/03/2020
B	Updated following project design changes, for DCO	25/11/2020
C	Updated following project design changes, for DCO	23/07/2021

Title: Hornsea Four
Document no: HOW04AN0001
Created by: DS
Checked by: JM
Approved by: SW

7.6 Methodology to inform baseline

7.6.1 Desktop study

7.6.1.1 A desk study was undertaken to obtain information on shipping and navigation. Data were acquired within each shipping and navigation study area through a detailed desktop review of existing studies and datasets.

7.6.1.2 The following sources of information in Table 7.5 were consulted.

Table 7.5: Key sources of desktop shipping and navigation data.

Source	Summary	Coverage of Hornsea Four Order Limits
Automatic Identification System (AIS) data	• AIS data featuring commercial ferries for the central and southern North Sea (12 months September 2018 to August 2019); • AIS data featuring commercial vessels considered potential users of the gap between Hornsea Four and Hornsea Project Two (12 months January 2019 to February 2020); • AIS winter and summer data for the Hornsea Four offshore ECC shipping and navigation study area (28 days February and August 2019); • AIS summer data for the Hornsea Four HVAC booster station search area shipping and navigation study area (14 days June 2020); • AIS summer data for the Hornsea Four array area shipping and navigation study area (14 days July/ August 2020); and • AIS summer and winter data for the Hornsea Four offshore ECC shipping and navigation study area (28 days July/August 2020 and February/ March 2021).	Hornsea Four area array, offshore ECC and HVAC booster search area.
Hornsea Offshore Wind Farm Project One Environmental Statement: Volume 5, Annex 5.8.1 – Subzone 1 & Offshore Cable Route Navigational Risk Assessment (Anatec 2013)	• Vessel traffic data used as a secondary source for characterising cumulative vessel traffic movements within and in proximity to the Hornsea wind farm developments.	Hornsea Four array area (partial).
Hornsea Offshore Wind Farm Project Two Environmental Statement: Volume 5, Annex 5.7.1 – Subzone 2 and Offshore Cable Route	• Vessel traffic data used as a secondary source for characterising cumulative vessel traffic movements within and in proximity to the Hornsea wind farm developments.	Hornsea Four array area (partial).

Source	Summary	Coverage of Hornsea Four Order Limits
Navigational Risk Assessment (Anatec 2015)		
Hornsea Project Three Offshore Wind Farm Environmental Statement: Volume 5, Annex 7.1 – Navigational Risk Assessment (Anatec 2018)	• Vessel traffic data used as a secondary source for characterising cumulative vessel traffic movements within and in proximity to the Hornsea wind farm developments.	Hornsea Four array area (partial).
SNSOWF Cumulative Navigational Issues in the Southern North Sea (Anatec 2013)	• Vessel traffic data used as a secondary source for characterising cumulative vessel traffic movements within and in proximity to the Hornsea wind farm developments.	Hornsea Four array area.
Anatec ShipRoutes database (2021)	• Main shipping routes developed by Anatec to assist in identifying passing vessel movements in proximity to proposed offshore developments.	Hornsea Four area array, offshore ECC and HVAC booster search area.
Port arrivals	• *UK ports: ship arrivals* (Department for Transport (DfT) 2020).	Hornsea Four area array, offshore ECC and HVAC booster search area.
Maritime incidents	• Marine Accident Investigation Branch (MAIB) marine accidents database (2010 to 2019); • Royal National Lifeboat Institution (RNLI) incident data (2010 to 2019); and • DfT UK civilian SAR helicopter taskings (2015 to 2020).	Hornsea Four area array, offshore ECC and HVAC booster search area.
Marine aggregate dredgers	• Marine aggregate dredging areas (licenced and active) (The Crown Estate (TCE) 2021); and • Transit routes (British Marine Aggregate Producers Association (BMAPA), published 2009, downloaded 2020).	Hornsea Four area array, offshore ECC and HVAC booster search area.
Recreational traffic density and features	• *UK Coastal Atlas of Recreational Boating 2.0* (RYA 2019).	Hornsea Four area array, offshore ECC and HVAC booster search area.
Other navigational features	• Admiralty Charts 121, 129, 266, 1187, 1190, 1191 and 2182A (United Kingdom Hydrographic Office (UKHO) 2021).	Hornsea Four area array, offshore ECC and HVAC booster search area.
Weather	• Met Office UK weather stations data for Bridlington, Donna Nook, Loftus, Wainsfleet and Weybourne (12 months September 2018 to August 2019).	Hornsea Four area array, offshore ECC and HVAC booster search area.

7.6.1.3 Commercial fishing vessel navigational activities were assessed using the vessel traffic survey data; however, the baseline findings of **Chapter 6: Commercial Fisheries** were also used as a secondary source.

7.6.1.4 Existing offshore oil and gas installations were identified using charted data including positional information on fixed platforms and wellheads, with future installations identified through consultation. Using these data, possible cumulative effects with other offshore installations, their support vessels and the increased risk associated with the platform locations were identified, with the latter assessed fully in **Chapter 11: Infrastructure and Other Users**.

7.6.1.5 Marine aggregate dredging data (licensed areas and active areas) were obtained from TCE. This information was used to identify commercial aggregate dredging activity and transit routes in proximity to the Hornsea Four array area and offshore ECC.

7.6.1.6 Other navigational features such as IMO Routeing measures and Ministry of Defence (MOD) Practice and Exercise Areas (PEXA) have been considered using charted data.

7.6.1.7 Vessel routeing identified by the vessel traffic data collected as part of site-specific surveys (see **Table 7.6**) and from consultation feedback has been validated using Anatec's ShipRoutes database which has been developed over a number of years using historical AIS data. It is regularly updated to ensure any changes to historical routeing or vessel numbers are reflected.

7.6.2 Site-Specific Surveys

7.6.2.1 To inform the EIA, site-specific surveys have been undertaken, as agreed with the MCA and Trinity House. A summary of surveys is outlined in **Table 7.6**. It is noted that the initial surveys undertaken (in 2019) are not fully compliant with MGN 654 due to the collection period being more than 24 months prior to the DCO application. Subsequently, the Applicant has undertaken additional surveys in 2021 to ensure this requirement of MGN 654 is satisfied. the Applicant consulted with the MCA in February 2021 with regard to this approach, with the MCA content with the methodology.

7.6.2.2 In this chapter and **Volume A5, Annex 7.1: Navigational Risk Assessment**, the winter 2021 surveys are used alongside an AIS only dataset from summer 2020 to characterise vessel traffic movements within and in proximity to the Hornsea Four array area and HVAC booster station search area. Analysis of the data collected in the summer 2021 surveys (undertaken in June and July) is presented as a validation exercise (see Appendix F of **Volume A5, Annex 7.1: Navigational Risk Assessment**). With all of the 2021 survey datasets considered collectively, it is possible to consider seasonal variations in shipping activity (i.e. summer/winter) as per the requirements of MGN 654.

7.6.2.3 The 2019 surveys (undertaken in Jan/Feb and July/August) have been considered as a secondary source and are presented in Appendix E of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

Table 7.6: Summary of site-specific survey data.

Title, Year and Reference	Summary	Coverage of Hornsea Four DCO boundary
AIS, visual and Radar vessel traffic survey 11 January to 15 February 2019	AIS, visual and Radar winter vessel traffic survey data for the Hornsea Four array area shipping and navigation study area covering 14 full days, noting that this dataset is not fully compliant with MGN 654 due to the collection period being more than 24 months prior to the DCO application.	Hornsea Four array area.
AIS, visual and Radar vessel traffic survey 13 January to 15 February 2019	AIS, visual and Radar winter vessel traffic survey data for the Hornsea Four HVAC booster station search area shipping and navigation study area covering 14 full days, noting that this dataset is not fully compliant with MGN 654 due to the collection period being more than 24 months prior to the DCO application.	Hornsea Four HVAC booster station search area.
AIS, visual and Radar vessel traffic survey 19 July to 2 August 2019	AIS, visual and Radar summer vessel traffic survey data for the Hornsea Four array area shipping and navigation study area covering 14 full days, compliant with MGN 654, noting that this dataset is not fully compliant with MGN 654 due to the collection period being more than 24 months prior to the DCO application.	Hornsea Four array area.
AIS, visual and Radar vessel traffic survey 3 to 17 August 2019	AIS, visual and Radar summer vessel traffic survey data for the Hornsea Four HVAC booster station search area shipping and navigation study area covering 14 full days, noting that this dataset is not fully compliant with MGN 654 due to the collection period being more than 24 months prior to the DCO application.	Hornsea Four HVAC booster station search area.
AIS, visual and Radar vessel traffic survey 24 February to 10 March 2021	AIS, visual and Radar winter vessel traffic survey data for the Hornsea Four array area shipping and navigation study area covering 14 full days, fully compliant with MGN 654.	Hornsea Four array area.
AIS, visual and Radar vessel traffic survey 10 to 24 March 2021	AIS, visual and Radar winter vessel traffic survey data for the Hornsea Four HVAC booster station search area shipping and navigation study area covering 14 full days, fully compliant with MGN 654.	Hornsea Four HVAC booster station search area.

Title, Year and Reference	Summary	Coverage of Hornsea Four DCO boundary
AIS, visual and Radar vessel traffic survey 22 June to 6 July 2021	AIS, visual and Radar summer vessel traffic survey data for the Hornsea Four HVAC booster station search area shipping and navigation study area covering 14 full days, fully compliant with MGN 654.	Hornsea Four HVAC booster station search area.
AIS, visual and Radar vessel traffic survey 6 to 20 July 2021	AIS, visual and Radar summer vessel traffic survey data for the Hornsea Four array area shipping and navigation study area covering 14 full days, fully compliant with MGN 654.	Hornsea Four array area.

7.7 Baseline environment

7.7.1.1 Baseline data has been compiled in line with guidance contained in MGN 654 (MCA 2021) and following consultation as described in **Table 7.5**. Full detail can be found in **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.7.2 Existing baseline

Navigational features

7.7.2.1 A plot of the key navigational features within the southern North Sea in proximity to Hornsea Four is presented in **Figure 7.2**.

Hornsea Four

Figure 7.2

Navigational features in proximity to Hornsea Four

Hornsea Four Boundaries

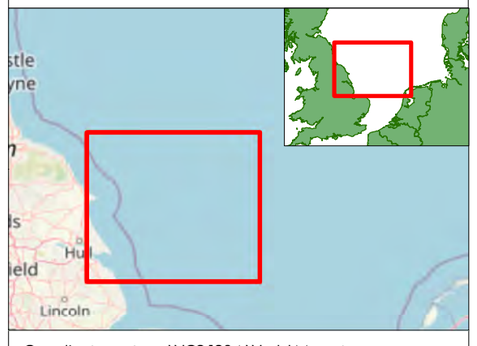
- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Offshore Temporary Works Area

Other Hornsea Developments

- Hornsea Project One
- Hornsea Project Two
- Hornsea Three
- Hornsea Project One HVAC Booster Station
- Hornsea Project Two Construction Buoy
- Hornsea Project One Export Cable

Navigational Features

- Surface Platform
- Production Well
- Suspended Well
- Tolmount Development Area
- Marine Aggregate Production Area
- Foul Ground
- Operational Offshore Wind Farm
- Consented Offshore Wind Farm
- Under Construction Offshore Wind Farm
- Firing Practice Area
- Submarine Pipeline
- Submarine Cable
- Pilot Boarding Location
- MEHRAs Line
- Aid to Navigation
- Anchorage Area
- IMO Routeing Measure
- Humber Port Limits
- Charted Wreck



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:900,000

0 2.5 5 10 Kilometres

0 2.5 5 10 Nautical Miles

REV	REMARK	DATE
	First Issue for PEIR	24/07/2019
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Title: Hornsea Four
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Date: 14/09/2021 Author: DS Name: 7.2 Navigational Features in Proximity to Hornsea Four

7.7.2.2 The key navigational features identified in proximity to the offshore aspects of Hornsea Four are detailed in Table 7.7.

Table 7.7: Details of key navigational features in proximity to Hornsea Four.

Navigational Feature	Details
Other offshore wind farm developments	The closest offshore wind farm development to the Hornsea Four array area is Hornsea Project Two, located approximately 1.9 nm to the south east. Hornsea Project One and Hornsea Three are located approximately 9.1 nm and 25 nm from the Hornsea Four array area, respectively. Beyond the former Hornsea Zone, there are other Round 3 sites located within the southern North Sea including the former Dogger Bank Zone and former East Anglia Zone located approximately 36 nm north east and 73 nm south east of the Hornsea Four array area, respectively.
Oil and gas features	There are two production wells within the Johnston gas field connected to the Ravenspurn North CCW platform (part of the Ravenspurn North Central Complex) which are located within the Hornsea Four array area alongside a suspended well. The Ravenspurn North Central Complex platforms are the closest surface platforms to the Hornsea Four array area located approximately 1.6 nm from the western boundary. The Tolmount gas field includes a surface platform located approximately 1.3 nm south east of the Hornsea Four HVAC booster station search area.
Aids to navigation	There are no aids to navigation located within the Hornsea Four array area. The closest aid to navigation is a north cardinal mark located approximately 1.8 nm south east of the Hornsea Four array area. This mark forms part of the construction buoyage for Hornsea Project Two and will be removed following the commissioning of the development. There is one aid to navigation located within the Hornsea Four offshore ECC. This is the south west Smithic light buoy, a west cardinal mark designed to assist with entering Bridlington harbour.
Submarine cables and pipelines	There are two submarine pipelines located within the Hornsea Four array area; both are associated with oil and gas features in the Southern North Sea.
Wrecks	There are seven charted wrecks located within the Hornsea Four array area, with the shallowest at 33 m below CD. There are three known wrecks located within the Hornsea Four offshore ECC, comprising two wrecks within 10 nm of the landfall site and one approximately 1.2 nm south of the Hornsea Four array area. There are no charted wrecks within the Hornsea Four HVAC booster station search area.
IMO Routeing measures	There are no IMO Routeing measures in proximity to the Hornsea Four array area and offshore ECC. However, the Inner Approaches TSS to the Humber, located approximately 36 nm south west of the Hornsea Four site is used by a large number of vessels which transit in proximity to Hornsea Four. Similarly, some vessels passing in proximity to Hornsea Four may use the Off Botney Ground TSS located approximately 57 nm east of the Hornsea Four array area.
Ports	There are several ports along the UK east coast with the closest port to the Hornsea Four array area being Bridlington located approximately 41 nm to the west on the east Yorkshire coast.
Marine Environment High Risk Areas (MEHRA)	There are two MEHRAs located in proximity to the Hornsea Four offshore ECC. The Flamborough Head MEHRA is in close proximity (less than 1 nm) to the landfall location while the Spurn Bight MEHRA is located at the Humber Estuary.

Vessel traffic in proximity to Hornsea Four array area

7.7.2.3 This section provides an overview of the vessel traffic within the Hornsea Four array area shipping and navigation study area. This includes 28 full days of vessel traffic data over two periods:

- 25 July to 7 August 2020 (14 days summer); and
- 24 February to 10 March 2021 (14 days winter).

7.7.2.4 These survey periods allow for the assessment to account for seasonal variations. The winter survey was undertaken from a survey vessel located at the Hornsea Four array area and incorporate visual observations and Radar data in addition to AIS data. The summer 2020 survey consists of AIS only, noting that, as per **Section 7.6.2**, a summer 2021 dataset incorporating AIS, visual observations and Radar data has been provided as a validation exercise (see Appendix F of **Volume A5, Annex 7.1: Navigational Risk Assessment**). Further information on the marine traffic survey methodology is provided in Section 7 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.7.2.5 Several vessel tracks recorded during the Hornsea Four array area survey periods were classified as temporary (non-routine), such as tracks of the survey vessel and tracks of vessels associated with the construction of Hornsea Project Two. These have therefore been excluded from the analysis. Oil and gas affiliated vessels supporting permanent installations were retained in the analysis.

7.7.2.6 A plot of the vessel tracks recorded during the 28-day survey period, colour-coded by vessel type and excluding temporary traffic, is presented in **Figure 7.3**.

7.7.2.7 For the 14 days analysed in the summer survey period, there were an average of 27 unique vessels per day recorded within the Hornsea Four array area shipping and navigation study area. In terms of vessels intersecting the Hornsea Four array area itself, there was an average of seven unique vessels per day.

7.7.2.8 For the 14 days analysed in the winter survey period, there were an average of 25 unique vessels per day recorded within the Hornsea Four array area shipping and navigation study area. In terms of vessels intersecting the Hornsea Four array area itself, there was an average of seven unique vessels per day.

7.7.2.9 Throughout the summer survey period, the main vessel types were cargo vessels (56% within the Hornsea Four array area), tankers (21%) and oil and gas affiliated vessels (18%). Throughout the winter survey period the main vessel types were also cargo vessels (60% within the Hornsea Four array area), tankers (18%) and oil and gas affiliated vessels (17%).

Hornsea Four

Figure 7.3

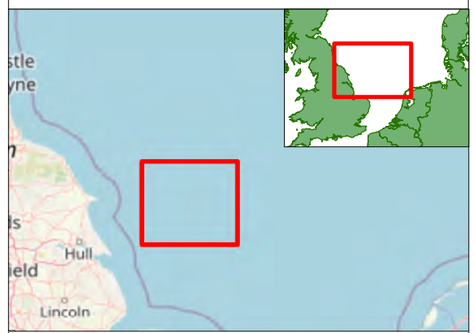
Vessel traffic survey data within Hornsea Four array area shipping and navigation study area colour-coded by vessel type (28 days summer 2020 and winter 2021)

Hornsea Four Boundaries

- Array Area
- Array Area Shipping and Navigation Study Area
- Offshore Export Cable Corridor
- Offshore Temporary Works Area

Vessel Type

- Unspecified
- Fishing
- Dredger/Subsea
- HSC
- Tug
- Passenger
- Cargo
- Tanker
- Other
- Recreational
- Oil and Gas
- Wind Farm



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:500,000

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0 5 10 Nautical Miles

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Date: 14/09/2021 Author: DS Name: 7-3 Vessel Traffic Survey Data within Hornsea Four Array Area

7.7.2.10 Vessel lengths overall (LOA) was available for more than 99% of vessels recorded throughout the survey periods and ranged from 7 m for a SAR vessel to 336 m for a crude oil tanker. Excluding the small proportion of vessels for which a length was not available the average length of vessels within the Hornsea Four array area shipping and navigation study area throughout the summer and winter survey periods were 115 m and 131 m, respectively.

7.7.2.11 Vessel draught was available for approximately 94% of vessel tracks recorded throughout the survey periods and ranged from 1.7 m for a wind farm vessel to 20.5 m for a crude oil tanker. Excluding those vessels for which a draught was not available (mainly non-AIS vessels) the average draught of vessels within the Hornsea Four array area shipping and navigation study area throughout the summer and winter survey periods were 6.0 m and 6.4 m, respectively.

7.7.2.12 Main routes have been identified using the principles set out in MGN 654 (MCA 2021). Vessels transiting at similar headings and locations are identified as a main route. Fourteen main commercial routes were identified as transiting through the Hornsea Four array area shipping and navigation study area. Plots of the main routes and corresponding 90th percentiles (areas within which 90% of vessel traffic transiting a route are situated as per MGN 654) within the Hornsea Four array area shipping and navigation study area are presented in **Figure 7.4**.

7.7.2.13 Details of the main routes (1 to 14), including the average number of vessels that transit through the Hornsea Four array area shipping and navigation study area on each route per day and the main vessel types are provided in **Table 7.8**. It is noted that the main routes reflect key directions of traffic routeing within the Hornsea Four array area shipping and navigation study area, and there are other commercial vessels operating outside of these routes.

Table 7.8: Description of main routes identified within Hornsea Four array area shipping and navigation study area.

Route number	Average transits per day	Description (main ports, also may include alternative ports)
1	2	**Immingham (UK)–Gothenburg (Sweden)**. Route 1 is generally transited by cargo vessels (81%) and tankers (11%) and is a DFDS Seaways cargo ferry route between Immingham and Gothenburg. The main vessels operating on this route are the *Begonia Seaways*, *Ficaria Seaways* and *Freesia Seaways*.
2	2	**Newcastle (UK)–Amsterdam (Netherlands)**. Route 2 is transited by passenger vessels (100%) and is a DFDS Seaways passenger ferry route between North Shields (UK) and Ijmuiden (Netherlands). The main vessels operating on this route are the *King Seaways* and *Princess Seaways*.
3	1 to 2	**Immingham–Esbjerg (Denmark)**. Route 3 is generally transited by cargo vessels (83%) and tankers (12%) and is DFDS Seaways cargo ferry route between Immingham and Esbjerg. The main vessels currently operating on this route are the *Magnolia Seaways* and *Petunia Seaways*.
4	1 to 2	**Immingham–Hamburg (Germany)**. Route 4 is generally transited cargo vessels (50%) and tankers (35%).

Route number	Average transits per day	Description (main ports, also may include alternative ports)
5	1	**Immingham–north Norway ports**. Route 5 is transited by cargo vessels (83%) and tankers (17%) and is a Sea-Cargo cargo ferry route between Immingham and Tananger (Norway).
6	1	**Grangemouth (UK)–Rotterdam (Netherlands)**. Route 6 is generally transited by cargo vessels (84%).
7	1	**Tees (UK)–Rotterdam**. Route 7 is generally transited by tankers (46%), cargo vessels (29%) and oil and gas vessels (11%).
8	1	**Tees–Rotterdam**. Route 8 is generally transited by cargo vessels (62%) and tankers (38%).
9	0 to 1	**Immingham–Antwerp (Belgium)**. Route 9 is generally transited by cargo vessels (53%) and tankers (40%).
10	0 to 1	**Immingham–Baltic ports**. Route 10 is generally transited by cargo vessels (85%) and tankers (12%).
11	0 to 1	**Great Yarmouth–Trent gas field**. Route 11 is transited by oil and gas vessels (100%).
12	0 to 1	**Immingham–Baltic ports**. Route 12 is transited by cargo vessels (100%).
13	0 to 1	**Immingham–northern Norway ports**. Route 13 is transited by cargo vessels (100%) and is a Finnlines cargo ferry route between Hull (UK) and Helsinki (Finland).
14	0 to 1	**Tees–Amsterdam**. Route 14 is generally transited by tankers (80%).

7.7.2.14 Throughout the survey periods 13 unique commercial ferries were identified, with 11 undertaking regular routes; each of these is among the main routes identified in **Table 7.8**.

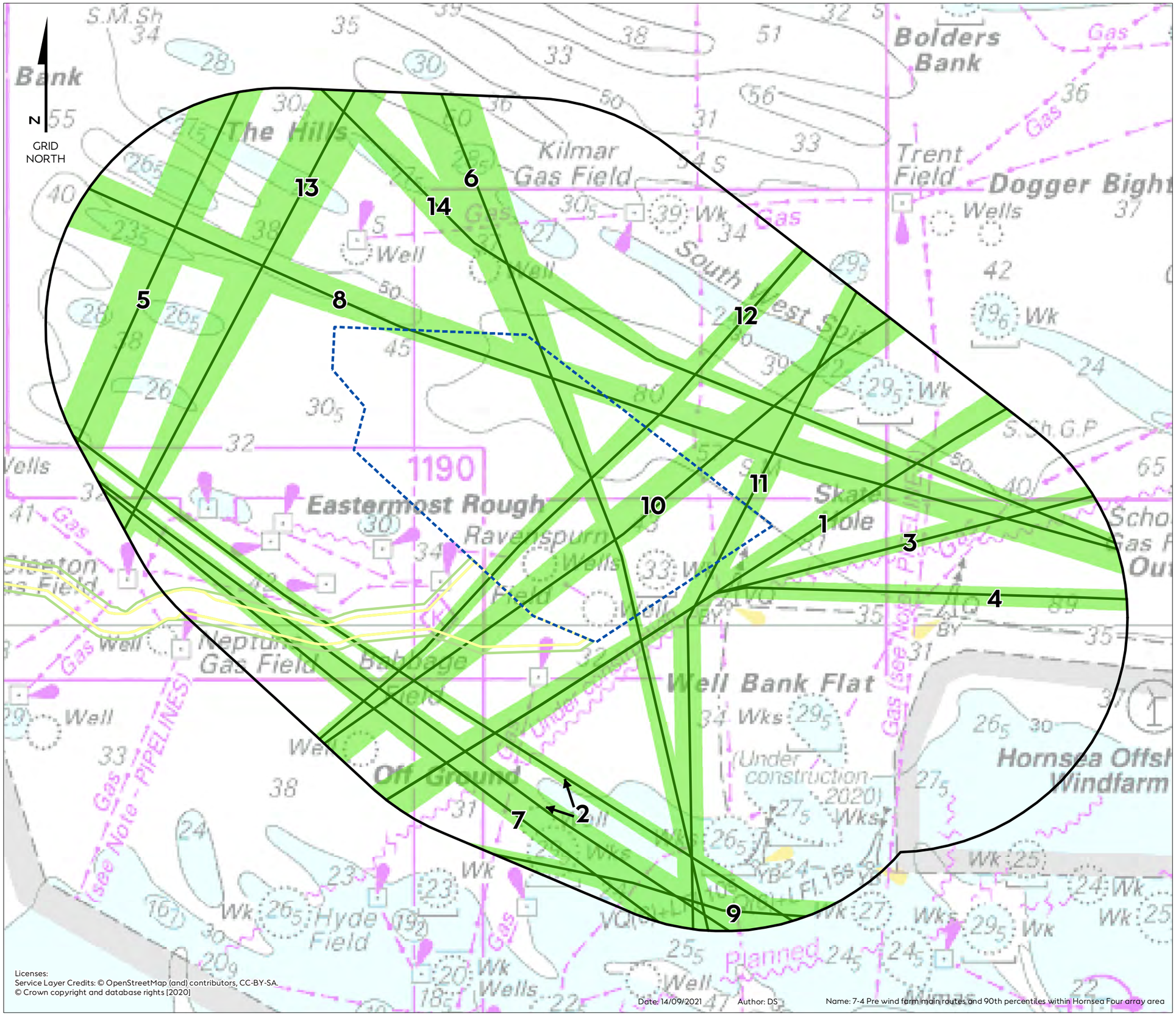
7.7.2.15 For the purposes of the shipping and navigation assessment, recreational activity includes sailing and motor craft (including those undertaking dive and fishing charter trips) of between 2.4 m and 24 m LOA. Throughout the survey periods only four vessel tracks were recorded within the Hornsea Four array area shipping and navigation study area, corresponding to an average of one unique recreational vessel every seven days. It is noted that all recreational craft recorded throughout the survey periods were recorded on AIS, with no recreational craft recorded on Radar.

7.7.2.16 Throughout the survey periods an average of one to two unique commercial fishing vessels per day passed within the Hornsea Four array area shipping and navigation study area. It is noted that only two fishing vessels were recorded on Radar throughout the winter survey period, corresponding to 5% of all fishing vessel traffic recorded. Commercial fishing vessel movements were limited within the Hornsea Four array area itself with those tracks recorded characteristic of commercial fishing vessels in transit and engaged in fishing activity.

Hornsea Four

Figure 7.4

Pre wind farm main routes and 90th percentiles within Hornsea Four array area shipping and navigation study area

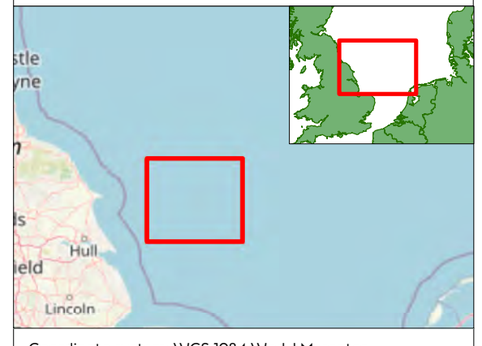


Hornsea Four Boundaries

- Array Area
- Array Area Shipping and Navigation Study Area
- Offshore Export Cable Corridor
- Offshore Temporary Works Area

Main Routes (Pre Wind Farm)

- Mean Position
- 90th Percentile



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:500,000

0 5 10 20 Kilometres

0 5 10 Nautical Miles

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Date: 14/09/2021 Author: DS Name: 7-4 Pre wind farm main routes and 90th percentiles within Hornsea Four array area

7.7.2.17 Although anchored vessels can be identified based upon their navigational status broadcast on AIS, it is common for vessels not to update their navigational status if only at anchor for a short period of time. For this reason, those vessels which travelled at a speed of less than 1 knot (kt) for more than 30 minutes had their corresponding vessel tracks individually checked for patterns characteristic of anchoring activity. After applying these criteria, only one vessel was deemed to be at anchor. This was a bulk carrier located approximately 1.7 nm east of the Hornsea Four array area. The vessel was anchored over a period of five days during July 2020 with its broadcast destination indicating that it was awaiting orders.

Maritime incidents in proximity to Hornsea Four array area

7.7.2.18 Detail on maritime incidents in proximity to the Hornsea Four array area can be found in Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

Vessel traffic in proximity to Hornsea Four offshore export cable corridor

7.7.2.19 This section provides an overview of the vessel traffic within the Hornsea Four offshore ECC shipping and navigation study area. This includes 28 full days of vessel traffic data over two periods:

- 25 July to 7 August 2020 (14 days summer); and
- 24 February to 10 March 2021 (14 days winter).

7.7.2.20 These survey periods allow for the assessment to account for seasonal variations. Both survey periods were characterised using AIS data from onshore sources given the large extent covered by the Hornsea Four offshore ECC shipping and navigation study area. This approach to establishing the vessel traffic baseline for the Hornsea Four offshore ECC follows the approach undertaken within the NRA for the previous Hornsea wind farm developments and the MCA have confirmed that they are satisfied with the data being used (see **Table 7.4**). Further information on the vessel traffic survey methodology is provided in Section 7 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.7.2.21 Several tracks recorded during the Hornsea Four offshore ECC survey periods were classified as temporary (non-routine), such as tracks of the survey vessel for the Hornsea Four array area and HVAC booster station search area. These have therefore been excluded from the analysis. Oil and gas affiliated vessels supporting permanent installations were retained in the analysis, although key vessels associated with temporary drilling operations in the Tolmount gas field have been excluded.

7.7.2.22 A plot of the vessel tracks recorded during the 28-day survey period, colour-coded by vessel type and excluding temporary traffic, is presented in **Figure 7.5**.

7.7.2.23 For the 14 days analysed in the summer survey period, there were an average of 55 unique vessels per day recorded within the Hornsea Four offshore ECC shipping and navigation study area. In terms of vessels intersecting the Hornsea Four offshore ECC itself, there was an average of 45 unique vessels per day.

7.7.2.24 For the 14 days analysed in the winter survey period, there were an average of 55 unique vessels per day recorded within the Hornsea Four offshore ECC shipping and navigation study area. In terms of vessels intersecting the Hornsea Four offshore ECC itself, there was an average of 46 unique vessels per day.

7.7.2.25 Throughout the summer survey period, the main vessel types were cargo vessels (37% within the Hornsea Four offshore ECC), tankers (22%) and commercial fishing vessels (19%). Throughout the winter survey period the main vessel types were cargo vessels (41% within the Hornsea Four offshore ECC), tankers (22%) and commercial fishing vessels (15%).

Maritime incidents in proximity to Hornsea Four offshore ECC

7.7.2.26 Detail on maritime incidents in proximity to the Hornsea Four offshore ECC can be found in Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

Vessel traffic in proximity to Hornsea Four HVAC booster station search area

7.7.2.27 This section provides an overview of the vessel traffic within the Hornsea Four HVAC booster station search area shipping and navigation study area. This includes 28 full days of vessel traffic data over two survey periods:

- 17 June to 30 June 2020 (14 days summer);
- 10 March to 24 March 2021 (14 days winter).

7.7.2.28 These survey periods allow for the assessment to account for seasonal variations. The winter survey was undertaken from a survey vessel located at the Hornsea Four HVAC booster station search area and incorporates visual observations and Radar data in addition to AIS data. The summer 2021 survey consists of AIS only, noting that, as per **Section 7.6.2**, a summer 2021 dataset incorporating AIS, visual observations and Radar data is provided as a validation exercise (see Appendix F of **Volume A5, Annex 7.1: Navigational Risk Assessment**). Further information on the vessel traffic survey methodology is provided in Section 7 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.7.2.29 Several tracks recorded during the Hornsea Four HVAC booster station search area survey periods were classified as temporary (non-routine), such as tracks of the survey vessel. These have therefore been excluded from the analysis. Oil and gas affiliated vessels supporting permanent installations were retained in the analysis, although key vessels associated with the temporary drilling operations in the Tolmount gas field have been excluded.

7.7.2.30 A plot of the vessel tracks recorded during the 28-day survey period, colour-coded by vessel type and excluding temporary traffic, is presented in **Figure 7.6**.

7.7.2.31 For the 14 days analysed in the summer survey period, there were an average of 34 unique vessels per day recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area. In terms of vessels intersecting the Hornsea Four HVAC booster station search area itself, there was an average of five unique vessels per day.

7.7.2.32 For the 14 days analysed in the winter survey period, there were an average of 47 unique vessels per day recorded within the Hornsea Four HVAC booster station search area shipping and navigation study area. In terms of vessels intersecting the Hornsea Four HVAC booster station search area itself, there was an average of four unique vessels per day.

7.7.2.33 Throughout the summer survey period, the main vessel types were cargo (48% within the Hornsea Four HVAC booster station search area) and tankers (46%). Throughout the winter survey period the main vessel types were tankers (48% within the Hornsea Four HVAC booster station search area), oil and gas affiliated vessels (29%) and cargo vessels (17%).

7.7.2.34 No anchored vessels were identified throughout the 28-day survey period.

Hornsea Four

Figure 7.5

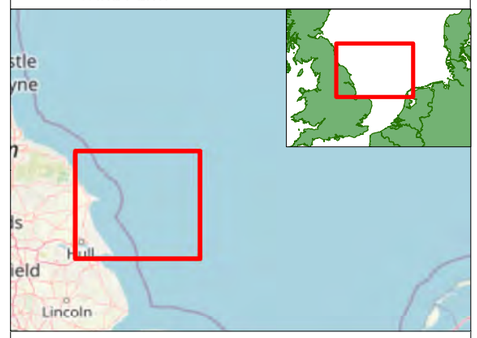
Vessel traffic survey data within Hornsea Four offshore ECC shipping and navigation study area colour-coded by vessel type (28 days summer 2020 and winter 2021)

Hornsea Four Boundaries

- Array Area
- HVAC Booster Station Works Area
- Offshore Export Cable Corridor
- Offshore Export Cable Corridor Shipping and Navigation Study Area
- Offshore Temporary Works Area

Vessel Type

- Fishing
- Military
- Dredger/ Subsea
- HSC
- Tug
- Passenger
- Cargo
- Tanker
- Other
- Recreational
- Oil and Gas
- Wind Farm



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:650,000

0 5 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
	First Issue for PEIR	24/07/2019
A	Updated following PEIR consultations, for DCO	11/03/2020
B	Updated following project design changes, for DCO	25/11/2020
C	Updated following project design changes, for DCO	23/07/2021

Title: Hornsea Four
Document no: HOW04AN0005
Created by: DS
Checked by: JM
Approved by: SW

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Date: 14/09/2021 Author: DS Name: 7-5 Vessel Traffic Survey Data within Hornsea Four HVAC

Hornsea Four

Figure 7.6

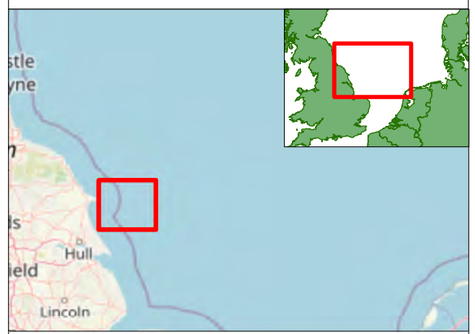
Vessel traffic survey data within Hornsea Four HVAC booster station search area shipping and navigation study area colour-coded by vessel type (28 days summer 2020 and winter 2021)

HVAC Booster Station Works Area

- HVAC Booster Station Works Area
- HVAC Booster Station Works Area Shipping and Navigation Study Area
- Offshore Export Cable Corridor
- Offshore Temporary Works Area

Vessel Type

- Unspecified
- Fishing
- Dredger/Subsea
- Tug
- Passenger
- Cargo
- Tanker
- Other
- Recreational
- Oil and Gas
- Wind Farm



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:300,000

0 5 10 Kilometres

0 3 6 Nautical Miles

REV	REMARK	DATE
	First Issue for PEIR	24/07/2019
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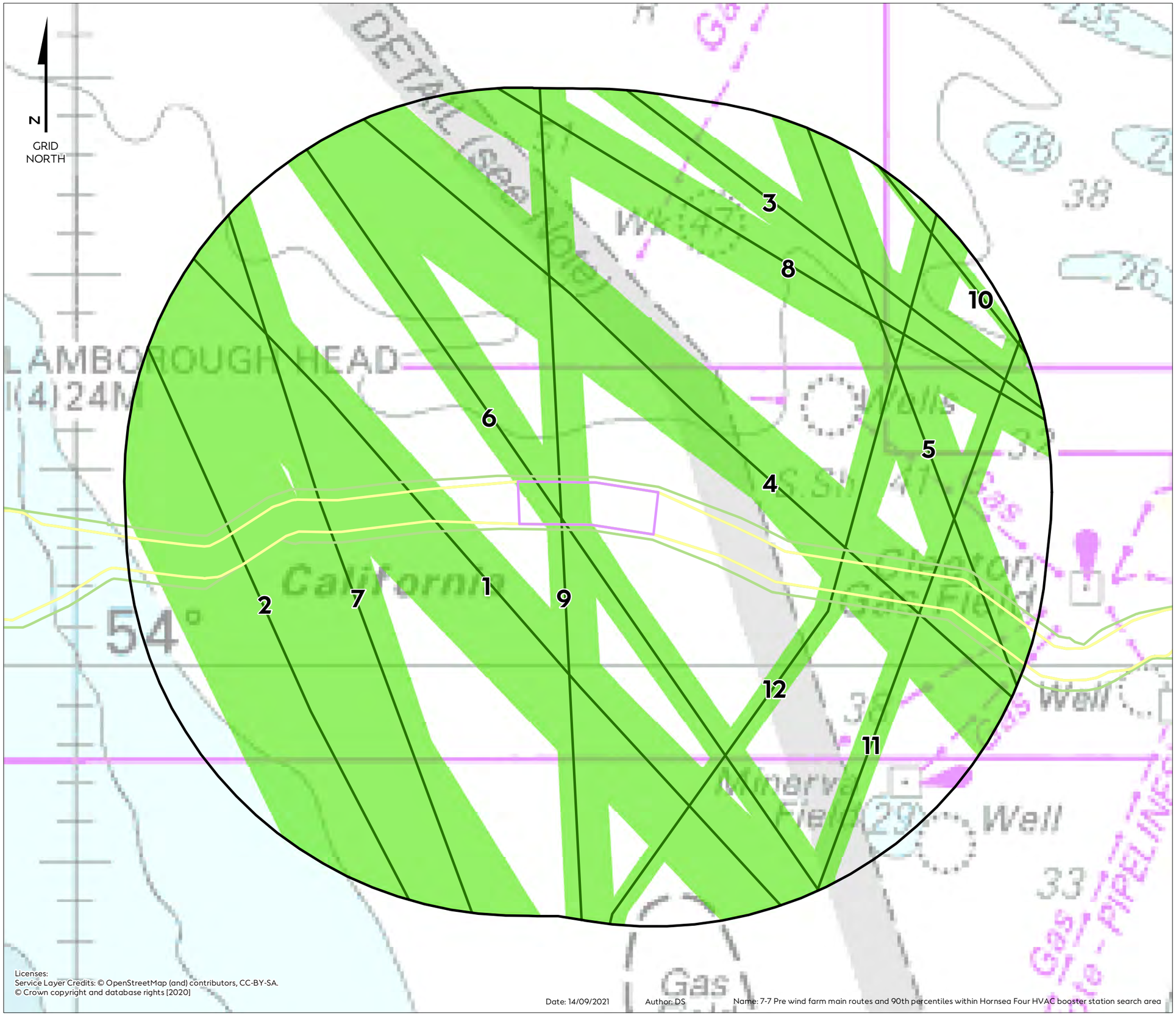
Date: 14/09/2021 Author: DS Name: 7-6 Vessel traffic survey data within Hornsea Four HVAC booster station search area

7.7.2.35 Vessel LOA was available for 99% of vessels recorded throughout the survey periods and ranged from 8 m for a small commercial fishing vessel to 269 m for a crude oil tanker. Excluding the small proportion of vessels for which a length was not available the average length of vessels within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the summer and winter survey periods were 103 m and 99 m, respectively.

7.7.2.36 Vessel draught was available for approximately 86% of vessel tracks recorded throughout the survey periods and ranged from 1.2 m for a wind farm vessel to 13.5 m for a crude oil tanker. Excluding those vessels for which a draught was not available the average draught of vessels within the Hornsea Four HVAC booster station search area shipping and navigation study area throughout the summer and winter survey periods were 5.4 m and 5.6 m, respectively.

7.7.2.37 Main routes have been identified using the principles set out in MGN 654 (MCA 2021) as per the routeing analysis undertaken for the Hornsea Four array area. Twelve main commercial routes were identified as transiting through the Hornsea Four HVAC booster station search area shipping and navigation study area. Plots of the main routes and corresponding 90th percentiles within the Hornsea Four HVAC booster station search area shipping and navigation study area are presented in **Figure 7.7**.

7.7.2.38 Details of the main routes (1 to 12), including the average number of vessels that transit through the HVAC booster station search area study area on each route per day and the main vessel types are provided in **Table 7.9**. It is noted that the main routes reflect key directions of traffic routeing within the Hornsea Four array area shipping and navigation study area, and there are other commercial vessels operating outside of these routes.



Hornsea Four

Figure 7.7

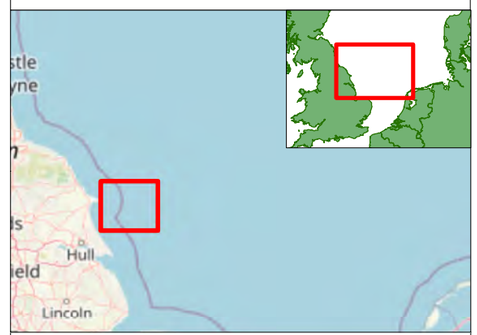
Pre wind farm main routes and 90th percentiles within Hornsea Four HVAC booster station search area shipping and navigation study area

HVAC Booster Station Works Area

- HVAC Booster Station Works Area
- HVAC Booster Station Works Area Shipping and Navigation Study Area
- Offshore Export Cable Corridor
- Offshore Temporary Works Area

Main Routes (Pre Wind Farm)

- Mean Position
- 90th Percentile



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:300,000

0 3 6 12 Kilometres

0 3 6 Nautical Miles

REV	REMARK	DATE
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Date: 14/09/2021 Author: DS Name: 7-7 Pre wind farm main routes and 90th percentiles within Hornsea Four HVAC booster station search area

Table 7.9: Description of main routes identified within Hornsea Four HVAC booster station search area shipping and navigation study area.

Route Number	Average Transits per Day	Description (main ports, also may include alternative ports)
1	9	**Tees–Rotterdam/Zeebrugge (Belgium)**. Route 1 is generally transited by cargo vessels (64%) and tankers (32%) and is a P&O Ferries and Euro Marine Carrier cargo ferry route between the Tees/Tyne and Rotterdam/Zeebrugge. The main vessels operating on this route are the *Bore Song* and *Estraden*.
2	8 to 9	**Tees–Rotterdam**. Route 2 is generally transited by cargo vessels (59%) and tankers (30%).
3	2*	**Newcastle–Amsterdam**. Route 3 is transited by passenger vessels (100%) and is a DFDS Seaways passenger ferry route between North Shields and Ijmuiden. The main vessels operating on this route are the *King Seaways* and *Princess Seaways*. It is noted that this is a continuation of Route 2 from the analysis of vessel routeing for the Hornsea Four array area (see Table 7.8).
4	1 to 2	**Tees–Amsterdam**. Route 4 is generally transited by cargo vessels (66%) and tankers (20%).
5	1	**Grangemouth–Rotterdam**. Route 5 is transited by cargo vessels (77%) and tankers (23%).
6	1	**Grangemouth–Rotterdam**. Route 6 is generally transited by tankers (55%) and cargo vessels (38%).
7	1	**Immingham–Moray Firth ports**. Route 7 is generally transited by cargo vessels (70%) and tankers (26%).
8	1	**Tees–Rotterdam**. Route 8 is transited by cargo vessels (75%) and tankers (25%).
9	1	**Immingham–north Norway ports**. Route 9 is transited by cargo vessels (43%), tankers (43%) and oil and gas vessels (14%).
10	0 to 1	**Grangemouth–Ghent**. Route 10 is generally transited by tankers (80%).
11	0 to 1	**Immingham–north Norway ports**. Route 11 is generally transited by cargo vessels (87%) and is a Sea-Cargo cargo ferry route between Immingham and Tananger. It is noted that this is a continuation of Route 5 from the analysis of vessel routeing for the Hornsea Four array area (see Table 7.8).
12	0 to 1	**Immingham–north Norway ports**. Route 12 is used by cargo vessels (73%) and tankers (27%).

7.7.2.39 Throughout the survey periods nine unique commercial ferries were identified, with three undertaking regular routes in both survey periods; each of these is among the main routes identified in Table 7.9. The commercial ferry activity includes adverse weather routeing by DFDS Seaways operated commercial ferries primarily from the winter survey period; these are considered further in Section 16 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.7.2.40 One recreational vessel was recorded during the summer survey period (noting that the summer period consisted of AIS only) and one recreational vessel was recorded during the winter survey period.

7.7.2.41 Throughout the survey periods, an average of five unique commercial fishing vessels per day passed within the HVAC booster station search area study area. A total of three commercial fishing vessels were recorded on Radar, with the rest recorded on AIS, including a large proportion of commercial fishing vessels under the mandatory 15 m length for AIS broadcast. Commercial fishing vessel movements were characteristic of both commercial fishing vessels in transit and engaged in fishing activity.

7.7.2.42 No vessels were identified as being at anchor during either study period within the HVAC booster station search area study area.

Maritime incidents in proximity to Hornsea Four HVAC booster station search area

7.7.2.43 Detail on maritime incidents in proximity to the Hornsea Four HVAC booster station search area can be found in Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.7.3 Current Baseline

7.7.3.1 The current baseline description above provides an accurate reflection of the current state of the existing environment. The earliest possible date for the start of any construction activities is January 2024, with an expected operational life of 35 years, and therefore there exists the potential for the baseline to evolve between the time of assessment and point of impact. Changes to the baseline in relation to shipping and navigation can occur over the long-term (considered in **Section 7.7.4**) or short to medium-term. The current baseline described above gives an accurate portrayal of the existing environment based on the most recent available data, and the baseline at the point of impact is expected to be broadly similar to this in most respects. However, it is noted that Hornsea Project Two will have progressed from the construction phase to the operation and maintenance phase by the point of impact of Hornsea Four.

7.7.4 Evolution of the baseline

7.7.4.1 The Infrastructure Planning (EIA) Regulations 2017 require that "*an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge*" is included within the ES (EIA Regulations, Schedule 4, Paragraph 3). From the point of assessment, over the course of the development and operational lifetime of Hornsea Four (operational lifetime anticipated to be 35 years), long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the evolution of the baseline environment, on the assumption that Hornsea Four is not constructed, using available information and scientific knowledge of shipping and navigation.

7.7.4.2 It is anticipated that, as with Hornsea Project One, commercial vessel traffic will choose to navigate around Hornsea Project Two once constructed rather than transit through the array. However, it is noted that the current baseline (with Hornsea Project Two under construction) is already reflective of this vessel behaviour, with commercial traffic choosing to navigate around the Hornsea Project Two buoyed construction area. Therefore, the position of the main commercial routes identified in **Section 7.7.2** is not expected to change substantially should Hornsea Four not be constructed.

7.7.4.3 In the event that Hornsea Four does come forward, the following is an assessment of the future baseline conditions in terms of the levels of vessel traffic.

7.7.4.4 Due to the distance offshore of the Hornsea Four array area, it is not considered likely that any increase in port traffic (i.e. vessels entering and exiting ports) would impact on the general traffic levels around the Hornsea Four array area and offshore ECC; therefore an indicative 10% increase in traffic associated with ports is applied in the future baseline.

7.7.4.5 An indicative 10% increase in commercial fishing vessel transits is applied in the future baseline to demonstrate potential impacts (in line with other renewables assessments). This value is used due to there being limited reliable information on future activity levels upon which any firm assumption could be made. Increases in commercial fishing activities are considered in a separate study of commercial fishing (see **Chapter 6: Commercial Fisheries**).

7.7.4.6 There are no known major developments which will increase the activity of recreational vessels within the southern North Sea. As with commercial fishing activity, given the lack of reliable information relating to future trends, a 10% increase is considered conservative.

7.7.4.7 During the construction phase there will be up to 6,126 return trips made by vessels involved in the installation of Hornsea Four (see **Table 7.11**). During the operation and maintenance phase there will be up to 1,433 return trips per year made by vessels involved in the operation and maintenance of Hornsea Four. This traffic has been considered in the future baseline.

7.7.4.8 It is not possible to consider all potential alternative routeing options for commercial traffic and therefore worst-case alternatives have been considered where possible in consultation with operators. Assumptions for re-routeing include:

- All alternative routes maintain a minimum distance of 1 nm from offshore installations and existing WTG boundaries in line with the MGN 654 Shipping Route Template (MCA 2021). This distance is considered for shipping and navigation from a safety perspective (see Section 20.5 of **Volume A5, Annex 7.1: Navigational Risk Assessment**); and
- All mean routes consider sandbanks and known routeing preferences; and
- All routes considered as potential users of the gap between Hornsea Four and Hornsea Project Two proceed to utilise the gap.

7.7.4.9 MGN 654 (MCA 2021) provides guidance to offshore renewable energy developers on both the assessment process and design elements associated with the development of an offshore wind farm. Annex 2 of MGN 654 defines a methodology for assessing passing distances between offshore wind farm boundaries but states that it is "*not a prescriptive tool but needs intelligent application*".

7.7.5 Data Limitations

Desk-Based Data Availability

7.7.5.1 The desk-based data used in this chapter are detailed in **Table 7.5**. The desk-based data sources used are the most up to date publicly available information. The data are therefore limited by what is available and by what has been made available, at the time of writing the ES including that in relation to historical incident data and information shown on UKHO Admiralty Charts.

Vessel Traffic Survey Compliance with MGN 654

7.7.5.2 The site specific survey data for the Hornsea Four array area and HVAC booster station search area as analysed in **Section 7.7.2** is limited to 14 days of AIS, visual and Radar data covered the winter period, with the 14 days covering the summer period including AIS only from desktop sources. This is not fully compliant with the requirements of MGN 654 which indicates that a minimum of 28 days of vessel traffic data including sources in addition to AIS should be used. In order to ensure compliance with MGN 654, new site-specific surveys were undertaken for the summer period in June and July 2021 with analysis of the data collected presented as a validation exercise (see Appendix F of **Volume A5, Annex 7.1: Navigational Risk Assessment**. The Applicant consulted with the MCA in February 2021 with regard to this approach, with the MCA content with the methodology. Moreover, given the low level of non-AIS vessel activity established from the site specific surveys undertaken to date, the desktop surveys undertaken provide a high level of confidence in the base case that it demonstrates.

7.7.5.3 It is noted that site-specific surveys including AIS, visual and Radar data have been undertaken for the summer period previously (July and August 2019) but fall outside of the 24-month window prior to the DCO application required by MGN 654. Nevertheless, these surveys are considered a useful secondary source for characterising vessel traffic movements within and in proximity to the Hornsea Four array area and HVAC booster station search area and analysis of these datasets in included in Appendix E of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

Effects of COVID-19

7.7.5.4 It is widely accepted that COVID-19 has had a substantial effect on shipping movements globally. Therefore, the vessel traffic survey data collected in 2020/21 may be influenced by COVID-19. However, in line with Advice Note Seven: Environmental Impact Assessment (PINS 2020), the Applicant has agreed the approach to data collection with relevant stakeholders including the MCA.

7.7.5.5 Additionally, a range of additional datasets predating the COVID-19 pandemic have been used as secondary sources for characterising vessel traffic movements. Most notably, this includes site specific surveys undertaken in January/February and July/August 2019 which included AIS, visual and Radar data (see Appendix E of **Volume A5, Annex 7.1: Navigational Risk Assessment**).

7.8 Project basis for assessment

7.8.1 Impact Register and Impacts not Considered in Detail in this ES

7.8.1.1 Upon consideration of the baseline environment, the project description outlined in **Volume A1, Chapter 4: Project Description**, the Hornsea Four Commitments detailed within **Volume A4, Annex 5.2: Commitments Register** and in response to formal consultation on the PEIR, all potential impacts have been considered in full for shipping and navigation.

7.8.1.2 In July 2019, Highways England issued an update to the DMRB significance matrix (see **Volume A1, Chapter 5: Environmental Impact Assessment Methodology**). Impacts formerly assessed within the category medium sensitivity and minor magnitude, as Minor (Not Significant), under the new guidance are now within the significance range of Slight or Moderate and therefore require professional judgement. Following a review of impacts, it was considered that the changes do not alter the overall significance of the impacts assessed at Scoping and in the PEIR (see **Volume A4, Annex 5.1: Impacts Register**).

7.8.1.3 Please note that the term "scoped out" as used above relates to the Likely Significant Effect (LSE) in EIA terms and not "scoped out" of the EIA process *per se*. All impacts "scoped out" of LSE are assessed for magnitude, sensitivity of the receiving receptor and conclude an EIA significance in the Impacts Register (see **Volume A4, Annex 5.1: Impacts Register**). This approach is aligned with the Hornsea Four proportionate approach to EIA (see **Volume A1, Chapter 5: EIA Methodology**).

7.8.2 Commitments

7.8.2.1 Hornsea Four has adopted commitments (primary design principles inherent as part of Hornsea Four, installation techniques and engineering designs/modifications) as part of their pre-application phase, to eliminate and/or reduce the LSE of a number of impacts to ALARP levels. These are outlined in **Volume A4, Annex 5.2 Commitments Register**. Further commitments (adoption of best practice guidance), referred to as tertiary commitments in **Table 7.10** below, are embedded as an inherent aspect of the EIA process. Secondary commitments are incorporated to reduce LSE to what is considered to be an acceptable level following initial assessment i.e. so that residual effects are reduced to a level that is considered to be not significant in EIA terms.

7.8.2.2 The commitments adopted by Hornsea Four in relation to shipping and navigation are presented in **Table 7.10**. Full details of the commitments are presented within **Volume A4, Annex 5.2: Commitments Register**.

Table 7.10: Relevant shipping and navigation commitments.

Commitment ID	Measure Proposed	How the Measure will be Secured
Co81	Tertiary: Where scour protection is required, MGN 654 will be adhered to with respect to changes greater than 5% to the under-keel clearance in consultation with the MCA.	DCO Schedule 11, Part 2 - Condition 15 and; DCO Schedule 12, Part 2 - Condition 15 (Offshore safety management)
Co83	Primary: Where possible, cable burial will be the preferred option for cable protection.	DCO Schedule 11, Part 2 - Condition 13(1)(h) and; DCO Schedule 12, Part 2 - Condition 13(1)(h) (Cable specification and installation Plan)
Co89	Tertiary: Advance warning and accurate location details of construction, maintenance and decommissioning operations, associated Safety Zones and advisory passing distances will be given via Notifications to Mariners and Kingfisher Bulletins.	DCO Schedule 11, Part 2 - Condition 7 and; DCO Schedule 12, Part 2 - Condition 7 (Notifications and inspections)
Co93	Tertiary: Aids to navigation (marking and lighting) will be deployed in accordance with the latest relevant available standard industry guidance and as advised by Trinity House, MCA and Civil Aviation Authority (CAA) and MOD as appropriate. This will include a buoyed construction area around the array area and the HVAC booster station in consultation with Trinity House.	DCO Schedule 11, Part 2 - Condition 8 and; DCO Schedule 12, Part 2 - Condition 8 (Aids to navigation) DCO Schedule 11, Part 2 - Condition 13(1)(j) and; DCO Schedule 12, Part 2 - Condition 13(1)(j) (Aids to navigation management plan)
Co94	Tertiary: The UKHO will be notified of both the commencement (within two weeks), progress and completion of offshore construction works (within two weeks) to allow marking of all installed infrastructure on nautical charts.	DCO Schedule 11, Part 2 - Condition 7(10) and; DCO Schedule 12, Part 2 - Condition 7(10) (Notifications and inspections)
Co96	Tertiary: The project commits to agree layout principles with the Marine Management Organisation (MMO), in consultation with the Maritime Coastguard Agency (MCA) and Trinity House.	DCO Schedule 11, Part 2 - Condition 13(1)(a) and; DCO Schedule 12, Part 2 - Condition 13(1)(a) (Pre-construction plans and documentation)
Co98	Tertiary: Monitoring and annual reporting of vessel traffic for the duration of the construction period.	DCO Schedule 11, Part 2 - Condition 18(2)(b) and; DCO Schedule 12, Part 2 - Condition 18(2)(b) (Construction monitoring)

Commitment ID	Measure Proposed	How the Measure will be Secured
Co99	Tertiary: Hornsea Four will ensure compliance with MGN 654 where appropriate.	DCO Schedule 11, Part 2 - Condition 15 and; DCO Schedule 12, Part 2 - Condition 15 (Offshore safety management)
Co139	Secondary: Safety Zones of up to 500 m will be applied during construction, maintenance and decommissioning phases. Where defined by risk assessment, guard vessels will also be used to ensure adherence with Safety Zones or advisory passing distances, as defined by risk assessment to mitigate impacts which pose a risk to surface navigation during construction, maintenance and decommissioning phases.	Application for Safety Zones to be made post consent under 'The Electricity (Offshore Generating Stations) (Safety Zones) (Applications Procedures and Control of Access) Regulations 2007 (SI No 2007/1948)'. Safety zones required are also detailed within **Volume A1, Chapter 4: Project Description**.
Co176	Tertiary: A Cable Specification and Installation Plan will be produced prior to construction of the offshore export cable which will include; details of cable burial depths; a detailed cable laying plan which ensures safe navigation is not compromised; details of cable protection for each cable crossing; and proposals for monitoring of offshore cable.	DCO Schedule 11, Part 2 - Condition 13(1)(h) and; DCO Schedule 12, Part 2 - Condition 13(1)(h) (Cable specification and installation plan)
Co177	Tertiary: Hornsea Four vessels will comply with *MGN 372 (Merchant and Fishing) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs* (MCA 2008) or the latest relevant available guidance where appropriate.	DCO Schedule 11, Part 2 - Condition 15 and; DCO Schedule 12, Part 2 - Condition 15 (Offshore safety management)
Co179	Secondary: Hornsea Four will ensure marine coordination with the Marine Helicopter Coordination Centre (MHCC).	DCO Schedule 11, Part 2 - Condition 13(1)(c)(x) and; DCO Schedule 12, Part 2 - Condition 13(1)(c)(x) (Construction method statement)
Co181	Tertiary: An Offshore Decommissioning Plan will be developed prior to decommissioning.	DCO Schedule 11, Part 1(6) and; DCO Schedule 12, Part 1(6) (General provisions)

7.9 Maximum Design Scenario

7.9.1.1 This section describes the Maximum Design Scenario (MDS) parameters on which the shipping and navigation assessment has been based. These are the parameters which are judged to be likely to give rise to the maximum levels of effect on shipping and navigation receptors and based on the range of design options set out in **Volume A1, Chapter 4: Project Description**. Should Hornsea Four be constructed to different parameters within the design envelope, then impacts would not be any greater than those set out in this ES using the MDS presented in **Table 7.11**.

Table 7.11: Maximum design scenario for impacts on shipping and navigation.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Construction			
Construction activities associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-C-1).	Secondary: Co139 Co179 Tertiary: Co89 Co93 Co99 Co177	**Construction Timeline:** • Single phase of offshore construction over approximately three years. **Buoyed Construction Areas:** • Maximum extent of the Hornsea Four array area including 500 m construction Safety Zones and 50 m pre-commissioning Safety Zones; and • 500 m construction Safety Zones deployed around the HVAC booster stations. **Construction Vessels:** • Up to eight construction vessels within a given 5 km^2 area with approximately three or four 5km^2 areas at any one time; • Up to 77 for the WTG foundations engaged at any given time with up to 2,880 return trips; • Up to 38 for the WTGs engaged at any given time with up to 900 return trips; • Up to 18 for substation and accommodation platform foundations engaged at any given time with up to 180 return trips; • Up to 18 for substation and accommodation platform installation engaged at any given time with up to 270 return trips; • Up to 18 for the inter-array and interconnector cables engaged at any one time with up to 1,488 return trips; and • Up to 24 for the export cables engaged at any given time with up to 408 return trips.	Largest extent and maximum number of construction vessels over the longest construction period with highest level of vessel activity.
Pre-commissioned structures within the Hornsea Four array area and HVAC booster station search area will create powered and	Secondary: Co139 Tertiary: Co89 Co93 Co94	**Construction Timeline:** • Single phase of offshore construction over approximately three years. **Array Area:** • Up to 180 WTGs on suction bucket jacket or piled jacket foundations (foundation with largest surface area at the sea surface).	Largest extent and maximum number of structures over the longest construction period.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
drifting allision risk for all vessels (SN-C-2).	Co99 Co177	• Up to six offshore transformer substations on Gravity-Base Structure (GBS) foundations (foundation with largest surface area at the sea surface); • Up to three offshore High Voltage Direct Current (HVDC) converter substations on GBS foundations (foundation with largest surface area at the sea surface); and • Up to one offshore accommodation platform on GBS foundations (foundation with largest surface area at the sea surface). **Offshore ECC:** • Up to three HVAC booster stations on GBS foundations with minimum spacing of 100 m (foundation with largest surface area at the sea surface).	
Pre-commissioned cables associated with the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels (SN-C-3).	Primary: Co83 Secondary: Co139 Tertiary: Co81 Co89 Co99 Co176	**Construction Timeline:** • Single phase of offshore construction over approximately three years. **Export Cables:** • Maximum export cable length of approximately 654 km (six cables of 109 km each), including within the Hornsea Four array area. **Inter Array and Interconnector Cables:** • Maximum length of array cables, up to 600 km; and • Up to six interconnector cables linking the offshore substations, up to 90 km (15 km in total length each).	Largest extent and maximum number of structures over the longest construction period.
Construction activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources (SN-C-4).	Secondary: Co179 Tertiary: Co89	**Construction Vessels and Helicopters:** • Up to eight construction vessels within a given 5 km^2 area with approximately three or four 5 km^2 areas at any one time; • Up to 77 construction vessels for the WTG foundations engaged at any given time with up to 2,880 return trips and up to 180 helicopter return trips; • Up to 38 construction vessels for the WTGs engaged at any given time with up to 900 return trips and up to 135 helicopter return trips;	Maximum number of construction vessels over the longest construction period.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
		• Up to 18 construction vessels for substation and accommodation platform foundations engaged at any given time with up to 180 return trips and up to 42 helicopter return trips; • Up to 18 construction vessels for substation and accommodation platform installation engaged at any given time with up to 270 return trips and up to 63 helicopter return trips; • Up to 18 construction vessels for the inter-array and interconnector cables engaged at any one time with up to 1,488 return trips and up to 396 helicopter return trips; and • Up to 24 construction vessels for the export cables engaged at any given time with up to 408 return trips and up to 800 helicopter return trips.	
Operation and Maintenance			
Presence of structures within the Hornsea Four array area, offshore ECC and HVAC booster station search area and activities associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore increased vessel to vessel collision risk for all vessel in all weather conditions (SN-O-5).	<u>Secondary:</u> Co178 Co179 <u>Tertiary:</u> Co89 Co94 Co99 Co177	**Operational Life:** • Operational life of 35 years. **Array Area:** • Structure deployment across full developable area; and • Maintenance Safety Zones of up to 500 m. **Operation and Maintenance Vessels:** • Up to 1,433 return trips per year by operation and maintenance vessels operational 24/7.	Largest extent over the longest operational period with most operational activity.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Operational structures within the Hornsea Four array area and HVAC booster station search area may create powered and drifting allision risk for all vessels (SN-O-6).	Secondary: Co179 Tertiary: Co89 Co93 Co94 Co96 Co99 Co177	**Operational Life:** • Operational life of 35 years. **Array Area:** • Up to 180 WTGs on suction bucket jacket or piled jacket foundations (foundation with largest surface area at the sea surface); • Up to six offshore transformer substations on GBS foundations (foundation with largest surface area at the sea surface); • Up to three offshore HDVC converter substations on GBS foundations (foundation with largest surface area at the sea surface); • Up to one offshore accommodation platform on GBS foundations (foundation with largest surface area at the sea surface); • Minimum spacing of 810 m between structures within the Hornsea Four array area; • Maintenance Safety Zones of up to 500 m. **Offshore ECC:** • Up to three HVAC booster stations on GBS foundations (foundation with largest surface area at the sea surface); and • Minimum spacing of 100 m between the HVAC booster stations; and • Maintenance Safety Zones of up to 500 m.	Largest extent and maximum number of operation and maintenance vessels over the longest operational period.
Operational cables within the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels and cable protection used may reduce navigable water depths for all vessels (SN-O-7).	Primary: Co83 Secondary: Co139 Tertiary: Co81 Co89 Co99 Co176	**Operational Life:** • Operational life of 35 years. **Export Cables:** • Maximum export cable length of approximately 654 km (six cables of 109 km each), including within the Hornsea Four array area. **Inter Array and Interconnector Cables:** • Maximum length of array cables, up to 600 km; and • Up to six interconnector cables linking the offshore substations, up to 90 km (15 km in total length each).	Largest extent and maximum number of structures over the longest operational period with use of cable burial protection.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Operation and maintenance activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources (SN-O-8).	Secondary: Co179 Tertiary: Co96 Co99	**Operational Life:** • Operational life of 35 years. **Operation and maintenance vessels:** • Up to 1,433 return trips per year by operation and maintenance vessels and/or helicopters operational 24/7.	Maximum number of operation and maintenance vessels over the longest operational period.
Operational structures within the Hornsea Four array area and offshore ECC may impact a vessel's use of its Radar, communications and navigation equipment during navigational transits (SN-O-9).	Tertiary: Co99	**Operational Life:** • Operational life of 35 years. **Array Area:** • Up to 180 WTGs on suction bucket jacket or piled jacket foundations (foundation with largest surface area at the sea surface); • Up to six offshore transformer substations on GBS foundations (foundation with largest surface area at the sea surface); • Up to three offshore HDVC converter substations on GBS foundations (foundation with largest surface area at the sea surface); • Up to one offshore accommodation platform on GBS foundations (foundation with largest surface area at the sea surface); • Minimum spacing of 810 m between structures within the Hornsea Four array area; and • Maintenance Safety Zones of up to 500 m. **Offshore ECC:** • Up to three HVAC booster stations on GBS foundations (foundation with largest surface area at the sea surface); • Minimum spacing of 100 m between the HVAC booster stations; and • Maintenance Safety Zones of up to 500 m.	Largest extent and maximum number of structures over the longest operational period.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Decommissioning			
Decommissioning activities associated with the Hornsea Four array area and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore increased vessel to vessel collision risk for all vessels in all weather conditions (SN-D-10).	Secondary: Co139 Co179 Tertiary: Co89 Co93 Co99 Co177 Co181	**Decommissioning Timeline:** • Single phase of offshore decommissioning over approximately three years. **Buoyed Decommissioning Areas:** • Buoyed decommissioning area deployed around the maximum extent of the Hornsea Four array area including 500 m decommissioning Safety Zones; and • Buoyed decommissioning area deployed around the HVAC booster stations including 500 m decommissioning Safety Zones.	Largest extent over the longest decommissioning period.
Decommissioning structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-D-11).	Secondary: Co139 Tertiary: Co89 Co93 Co94 Co99 Co177 Co181	**Decommissioning Timeline:** • One phase of offshore decommissioning over approximately three years. **Array Area:** • Up to 180 pre-decommissioned WTGs on suction bucket jacket or piled jacket foundations (foundation with largest surface area at the sea surface); • Up to six pre-decommissioned offshore transformer substations on GBS foundations (foundation with largest surface area at the sea surface); • Up to three pre-decommissioned offshore HVDC converter substations on GBS foundations (foundation with largest surface area at the sea surface); and • Up to one pre-decommissioned offshore accommodation platform on GBS (foundation with largest surface area at the sea surface). **Offshore ECC:** • Up to three pre-decommissioned HVAC booster stations on GBS foundations with minimum spacing of 100 m (foundation with largest surface area at the sea surface).	Largest extent and maximum number of structures over the longest decommissioning period.

Impact and Phase	Embedded Mitigation Measures	Maximum Design Scenario / Rochdale Envelope	Justification
Decommissioned cables left in situ within the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels (SN-D-12).	Primary: Co83 Secondary: Co139 Tertiary: Co81 Co89 Co99 Co176 Co181	**Decommissioning Timeline:** • Single phase of offshore decommissioning over approximately three years. **Export Cables:** • Maximum export cable length of approximately 654 km (six cables of 109 km each, including within the Hornsea Four array area) left in situ. **Inter Array and Interconnector Cables:** • Maximum length of array cables, up to 600 km left in situ; and • Up to six interconnector cables linking the offshore substations, up to 90 km (15 km in total length each) left in situ.	Largest extent and maximum number of structures over the longest decommissioning period. Cables left in situ.
Decommissioning activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources (SN-D-13).	Secondary: Co179 Tertiary: Co99 Co181	**Decommissioning Timeline:** • Single phase of offshore decommissioning over approximately three years. **Decommissioning Vessels:** • Up to eight decommissioning vessels within a given 5 km^2 area with approximately three or four 5 km^2 areas at any one time; • Up to 77 decommissioning vessels for the WTG foundations engaged at any given time with up to 2,880 return trips and up to 180 helicopter return trips; • Up to 38 decommissioning vessels for the WTGs engaged at any given time with up to 900 return trips and up to 135 helicopter return trips; • Up to 18 decommissioning vessels for substation foundations engaged at any given time with up to 180 return trips and up to 42 helicopter return trips; • Up to 18 decommissioning vessels for the substation and accommodation platforms engaged at any given time with up to 270 return trips and up to 63 helicopter return trips; • Up to 18 decommissioning vessels for the inter-array and interconnector cables engaged at any one time with up to 1,488 return trips and up to 396 helicopter return trips; and • Up to 24 decommissioning vessels for the export cables engaged at any given time with up to 408 return trips and up to 800 helicopter return trips.	Maximum number of construction vessels over the longest decommissioning period.

7.10 Assessment methodology

7.10.1.1 The assessment methodology for shipping and navigation is consistent with guidance provided by the key regulator, the MCA, and where there is no conflict in methodologies this topic is also assessed in line with Annex C of the Scoping Report and **Volume A1, Chapter 5 Environmental Impact Assessment Methodology**. The primary guidance documents used when assessing impacts are listed in Section 2 of **Volume A5, Annex 7.1: Navigational Risk Assessment**. In order to undertake a proportionate assessment, the regulator required FSA approach is built into the definition for the magnitude of impact defined in **Table 7.13**.

7.10.1.2 The MCA require that their methodology is used as a template for undertaking impact assessments (MCA 2021). This template is based on the IMO FSA process. The FSA centres on risk management and requires that any application demonstrates that sufficient controls are, or will be, in place for the assessed risk (base case and future case) to be judged as broadly acceptable or tolerable.

7.10.2 Hazard Workshops

7.10.2.1 In order to gather expert opinion and local knowledge, two Hazard Workshops were undertaken during which a project and site-specific hazard log was prepared (see Appendix B of **Volume A5, Annex 7.1: Navigational Risk Assessment**). The hazard log identified hazards relating to Hornsea Four, the level of risk associated with the hazards, the controls to be put in place and the tolerability of the residual risks.

7.10.2.2 The hazard log also identifies any commitments required to show that the hazards associated with Hornsea Four are broadly acceptable or tolerable in line with FSA and ALARP declarations, in line with regulatory requirements. This information was then fed into the assessment of significance of effect process (see **Table 7.14**) to aid identification of impacts associated with the development and the assessment of the significance of effects arising from those impacts.

7.10.2.3 It is noted that a change to the Hornsea Four array area boundary at the north western extent (incorporated into the design envelope since the second Hazard Workshop) has not been discussed at a Hazard Workshop with the MCA and Trinity House in agreement that this change was not of material effect for shipping and navigation receptors (see 1 April 2021 entry in **Table 7.4**). However, it was considered prudent to review the hazard log following the change.

7.10.3 Impact assessment criteria

7.10.3.1 The criteria for determining the significance of effects is a two-stage process that involves defining the sensitivity of the receptors and the magnitude of the impacts. This section describes the criteria applied in this chapter to assign values to the sensitivity of receptors and the magnitude of potential impacts. They also reference a consequence level in line with the FSA methodology required by the MCA.

7.10.3.2 The sensitivity of the receptor is defined by the:

- Vulnerability;
- Recoverability; and
- Value/importance of that receptor.

7.10.3.3 For the shipping and navigation assessment the following factors were also taken into consideration:

- Consultation feedback from stakeholders and Regular Operators;
- Outputs of the Hazard Workshops;
- Lessons learned and research from previous developments, especially impacts associated with navigation and communication, where physical modelling is not available;
- Analysis of baseline data;
- Results of collision and allision risk modelling; and
- Clear evidence of impact (i.e. deviations).

Table 7.12: Definition of terms relating to receptor sensitivity.

Sensitivity	Definition used in this Chapter
Very High	Receptor is of critical value to the local, regional or national economy and/or the receptor is highly vulnerable to impacts with regard to navigational safety that may arise from Hornsea Four and/or recoverability is long term or not possible. Major severity of consequence under FSA assessment.
High	Receptor is of high value to the local, regional or national economy and/or the receptor is generally vulnerable to impacts with regard to navigational safety that may arise from Hornsea Four and/or recoverability is slow or costly. Serious severity of consequence under FSA assessment.
Medium	Receptor is of medium value to the local, regional or national economy and/or the receptor is somewhat vulnerable to impacts with regard to navigational safety that may arise from Hornsea Four and/or has good levels of recoverability. Moderate severity of consequence under FSA assessment.
Low	Receptor is of low value to the local, regional or national economy and/or the receptor is not or generally not vulnerable to impacts with regard to navigational safety that may arise from Hornsea Four and/or has very good recoverability. Minor severity of consequence under FSA assessment.

7.10.3.4 The magnitude of an impact is defined by the:

- Spatial extent;
- Duration (long, medium or short term);
- Frequency or risk of occurrence; and
- Reversibility of the effect.

7.10.3.5 The criteria for defining magnitude in this chapter are outlined in **Table 7.13** below. They also reference a frequency level in line with the FSA methodology required by the MCA.

Table 7.13: Definition of terms relating to magnitude of an impact.

Magnitude of Impact	Definition used in this Chapter
Major	• The receptor is of international extent; • The impact would be of long-term duration meaning continuous throughout all phases; • The impact would not be reversible throughout all phases; • The impact will be reversible post decommissioning; and • Frequent occurrence under FSA assessment.
Moderate	• The receptor is of national extent; • The impact would be of medium duration meaning continuous throughout a phase; • The impact would not be reversible throughout all phases; • The impact will be reversible post decommissioning; and • Reasonably probable occurrence under FSA assessment.
Minor	• The receptor is of local or national extent; • The impact would be of medium duration meaning continuous throughout a phase; • The impact could be reversible dependant on phase; • The impact will be reversible post decommissioning; and • Remote occurrence under FSA assessment.
Negligible	• The receptor is of local extent; • The impact would be of short duration meaning intermittent throughout a phase; • The impact could be reversible dependant on phase; • The impact will be reversible post decommissioning; and • Negligible or extremely unlikely occurrence under FSA assessment.

7.10.3.6 The significance of the effect upon shipping and navigation is determined by correlating the magnitude of the impact and the sensitivity of the receptor. The significance of effect has also been aligned with FSA rankings. The method employed for this assessment is presented in **Table 7.14**. Where a range of significance of effect is presented in **Table 7.14**, the final assessment for each effect is based upon expert judgement.

7.10.3.7 For the purposes of this assessment, any effects with a significance level of slight or less have been concluded to be not significant in terms of the EIA Regulations. Under FSA regulations impacts that are broadly acceptable or tolerable with mitigation are considered to be ALARP.

Table 7.14: Matrix used for the assessment of the significance of the effect.

		Magnitude of impact (degree of change)			
		Negligible	*Minor*	*Moderate*	*Major*
Environmental value (sensitivity)	*Low*	Neutral or Slight (Not Significant)	Neutral or Slight (Not Significant)	Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)
	Medium	Neutral or Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)	Moderate or Large (Significant)	Moderate or Large (Significant)
	High	Slight (Not Significant)	Slight (Not Significant) or Moderate (Significant)	Moderate or Large (Significant)	Large or Very Large (Significant)
	Very High	Slight (Not Significant)	Moderate or Large (Significant)	Large or Very Large (Significant)	Very Large (Significant)

7.11 Impact assessment

7.11.1 Construction

7.11.1.1 The impacts of the offshore construction of Hornsea Four have been assessed on shipping and navigation (**Volume A4, Annex 5.1: Impacts Register**). The environmental impacts arising from the construction of Hornsea Four are listed in **Table 7.11** along with the maximum design scenario against which each construction phase impact has been assessed.

7.11.1.2 A description of the potential effect on shipping and navigation receptors caused by each identified impact is given below.

7.11.1.3 It is noted that the scope and assessment of impacts associated with oil and gas assets (as identified by the Hazard Workshops) are considered in a separate impact assessment undertaken in **Chapter 11: Infrastructure and Other Users**.

Construction activities associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-C-1)

7.11.1.4 Pre-wind farm vessel traffic movements around the Hornsea Four array area, offshore ECC and HVAC booster station search area have been captured through dedicated vessel traffic surveys and AIS surveys as summarised in **Section 7.7**. Vessel traffic survey data assessments are considered alongside historical data (including the Anatec ShipRoutes database) thus ensuring that a detailed overview of vessel movements has been defined for use in the assessment of this impact. Additionally, the evolution of the baseline has been considered (see **Section 7.7.4**), primarily through consultation with Regular Operators.

7.11.1.5 It is noted that this impact considers only the risk to navigational safety due to vessel deviations rather than the risk to commercial operations, given that stakeholders clearly differentiated between the two forms of risk during consultation. The commercial impact of vessel deviations is assessed as a transboundary effect in **Section 7.13**.

Main route deviations

7.11.1.6 Main route deviations have been considered in line with the MGN 654 Shipping Route Template (MCA 2021) and noting that during consultation Regular Operators indicated that:

- They would not enter the buoyed construction area; and
- They would transit through the gap between Hornsea Four and Hornsea Project Two.

7.11.1.7 It is noted that some main routes which have been deviated through the gap may pass around the Hornsea Four array area rather than utilise the gap; however to ensure the MDS is considered (maximum proximity to structures and minimum available sea room), such main routes are assumed to be potential gap users. A full methodology for main route deviations is provided in Section 20.5.1 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.11.1.8 Deviations would be required for five out of the 14 main routes identified within the Hornsea Four array area shipping and navigation study area in the existing baseline, with the level of deviation varying between 0.4 nm for Route 8 and 5.5 nm for Route 6.

7.11.1.9 For the displaced routes within the Hornsea Four array area shipping and navigation study area, the increase in distance and percentage change from the existing baseline are presented in **Table 7.15**. It is noted that increases in route length are based upon indicative final destinations and percentage changes are based upon the full route length. An illustration of the anticipated shift in the mean positions of the main commercial routes within the Hornsea Four array area shipping and navigation study area is presented in **Figure 7.8**.

Table 7.15: Summary of future baseline main route deviations within Hornsea Four array area shipping and navigation study area.

Route Number	Average Transits per Day	From Current Baseline	
		Increase in Route Length (nm)	Increase in Total Route Length (%)
6	1	5.5	1.5
8	1	0.4	0.1
10	0 to 1	2.9	0.8
11	0 to 1	1.0	1.0
12	0 to 1	4.6	1.3

7.11.1.10 The displaced routes do not pass any closer to the Dogger Bank than in the pre wind farm scenario, noting that in adverse weather conditions the Dogger Bank poses an increased risk to the safety of navigation and was raised as a particular concern during consultation.

7.11.1.11 Deviations would be required for two of the 12 main routes identified within the Hornsea Four HVAC booster station search area shipping and navigation study area in the existing baseline, with these being deviations of less than 0.1 nm for both Routes 6 and 9.

7.11.1.12 An illustration of the anticipated shift in the mean positions of the main commercial routes within the Hornsea Four HVAC booster station search area shipping and navigation study area is presented in **Figure 7.9**.

Hornsea Four

Figure 7.8

Post wind farm main routes within Hornsea Four array area shipping and navigation study area

Hornsea Four Boundaries

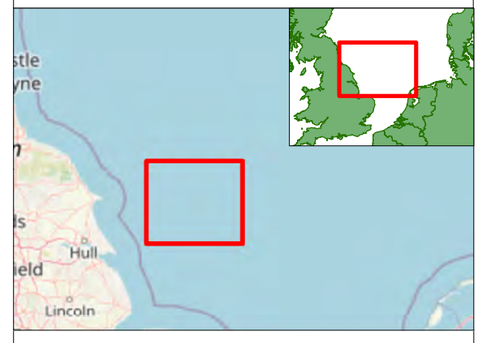
- Indicative Structure Location
- Array Area Shipping and Navigation Study Area

Hornsea Project Two

- Structure Location

Main Routes (Post Wind Farm)

- Mean Position (Post Hornsea Four)



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:500,000

0 5 10 20 Kilometres

0 5 10 Nautical Miles

REV	REMARK	DATE
	First Issue for PEIR	24/07/2019
A	Updated following PEIR consultations, for DCO	11/03/2020
B	Updated following project design changes, for DCO	25/11/2020
C	Updated following project design changes, for DCO	23/07/2021

Title: Hornsea Four
Document no: HOW04AN0008
Created by: DS
Checked by: JM
Approved by: SW

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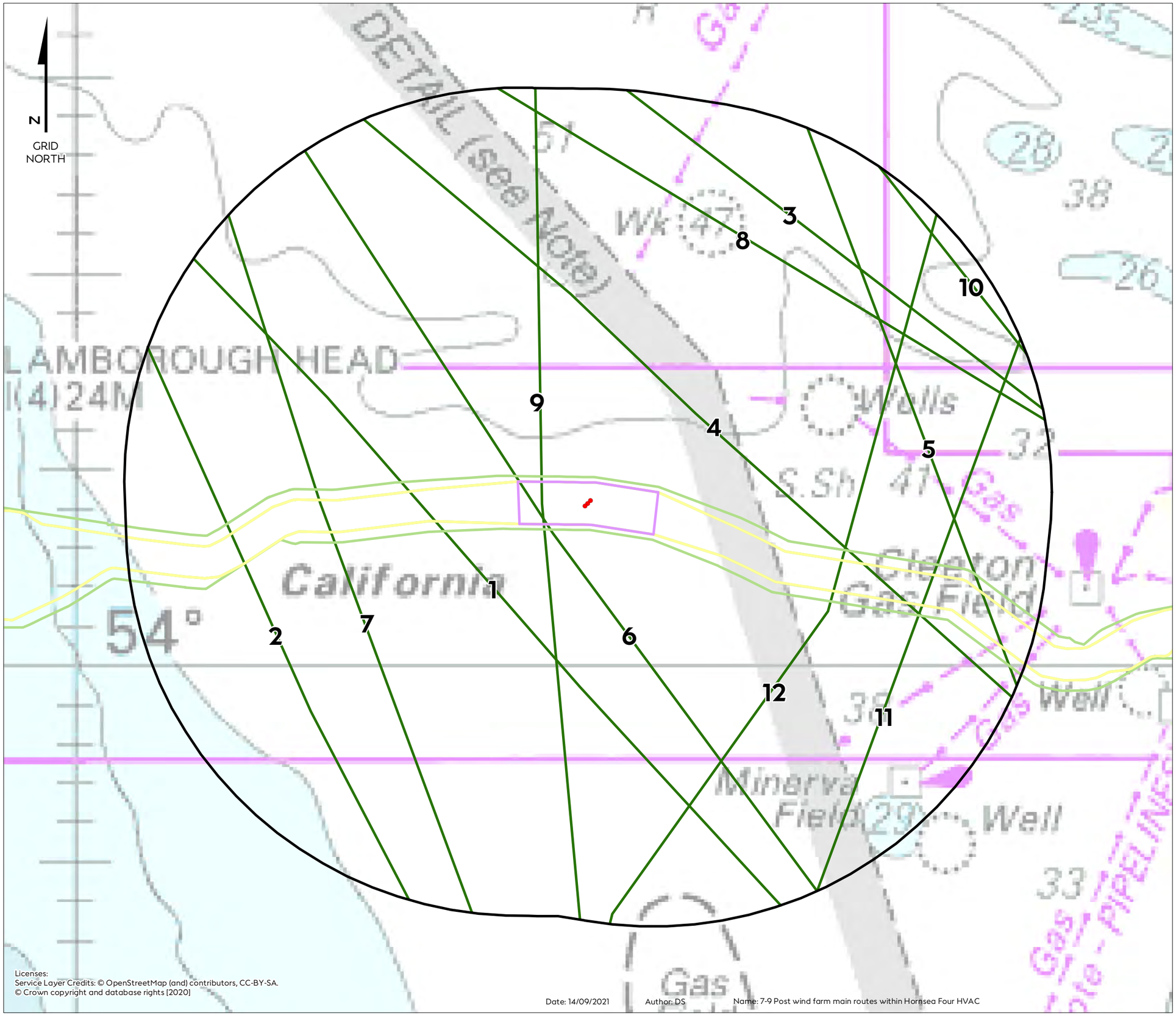
Date: 14/09/2021 Author: DS Name: 7-8 Post wind farm main routes within Hornsea Four array area

Hornsea Four

Figure 7.9

Post wind farm main routes within Hornsea Four HVAC booster station search area shipping and navigation study area

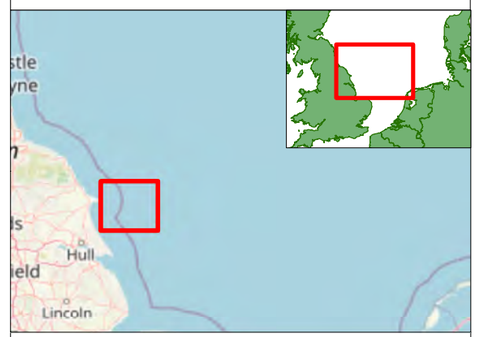


HVAC Booster Station Works Area

- HVAC Booster Station Works Area
- HVAC Booster Station Works Area Shipping and Navigation Study Area
- Offshore Export Cable Corridor
- Offshore Temporary Works Area
- Indicative HVAC Booster Station

Main Routes (Post Wind Farm)

- Mean Position



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:300,000

0 3 6 12 Kilometres

0 3 6 Nautical Miles

REV	REMARK	DATE
	First Issue for PEIR	24/07/2019
A	Updated following PEIR consultations, for DCO	11/03/2020
B	Updated following project design changes, for DCO	25/11/2020
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Date: 14/09/2021 Author: DS Name: 7-9 Post wind farm main routes within Hornsea Four HVAC

Adverse weather routeing

7.11.1.13 A definition of adverse weather in the context of vessel routeing is provided in Section 16 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.11.1.14 The potential effect on adverse weather routeing was raised during consultation undertaken with DFDS Seaways. Changes to DFDS Seaways commercial ferry routes in adverse weather conditions were assessed using long-term vessel traffic survey data (covering 12 months between September 2018 and August 2019) and information provided by DFDS Seaways during consultation. The findings are summarised in **Table 7.16**.

Table 7.16: Summary of findings from assessment of changes to DFDS Seaways commercial ferry routeing during adverse weather conditions.

DFDS Seaways Commercial Ferry Route	Changes in Adverse Weather Conditions
Immingham to Esbjerg (Route 1 in **Figure 7.4**)	In normal weather, vessels on this route pass south of the Hornsea Four array area and north of Hornsea Project One. From the vessel traffic survey data (see **Section 7.7.2**), it is known that normal weather transits also pass north of the now under construction Hornsea Project Two (the long-term AIS data pre-dates Hornsea Project Two construction). In adverse weather, vessels on this route pass south of Hornsea Project One, and thus not in proximity to the Hornsea Four array area. Based upon long-term AIS data this occurs for approximately 4% of all transits on this route.
Immingham to Gothenburg (Route 2)	In normal weather, vessels on this route pass south of the Hornsea Four array area and north of Hornsea Project One. From the vessel traffic survey data (see **Section 7.7.2**), it is known that normal weather transits also pass north of the now under construction Hornsea Project Two (the long-term AIS data pre-dates Hornsea Project Two construction). In adverse weather, vessels on this route take one of two alternative passages, both of which allow the Dogger Bank to be avoided: • North of the Dogger Bank: Passes in a north-south direction to the west of the Hornsea Four array area and north around the Dogger Bank. Based upon long-term AIS data this occurs for approximately 1% of all transits on this route. • South of the Dogger Bank: Passes further south of the Hornsea Four array area but still north of Hornsea Project One. Based upon long-term AIS data this occurs for approximately 4% of all transits on this route.
North Shields to Ijmuiden (Route 3)	In normal weather, vessels on this route generally passed along the western boundary of the Hornsea Four array area prior to the construction of Hornsea Project Two (2018/19 long-term data) and between the platforms in the Ravenspurn gas field following the start of Hornsea Project Two construction (2020/21 vessel traffic survey data). In adverse weather, vessels on this route make passage closer to the UK east coast, and thus not in proximity to the Hornsea Four array area. Based upon long-term AIS data this occurs for approximately 5% of all transits on this route.

7.11.1.15 In the cases of the Immingham to Esbjerg, Immingham to Gothenburg passing north of the Dogger Bank and North Shields to Ijmuiden adverse weather routes, because these routes do not pass in proximity to the Hornsea Four array area they are not anticipated to be significantly affected by the presence of the array.

7.11.1.16 In the case of the North Shields to Ijmuiden adverse weather route, the passage in proximity to the Hornsea Four HVAC booster station search area is similar to that of a number of existing commercial ferry routes (noting that there is a relatively high level of commercial ferry activity in the local area) and the presence of the HVAC booster stations is not expected to incur any deviation to the route. Therefore, the route is not anticipated to be significantly affected by the presence of the HVAC booster stations.

7.11.1.17 In the case of the Immingham to Gothenburg south of the Dogger Bank adverse weather route, this route could utilise the gap between Hornsea Four and Hornsea Project Two, noting the increased flexibility the gap offers for vessel movements compared to a navigational corridor. However, an alternative routeing option exists should this be considered unsuitable, with vessels on this route able to shift south of Hornsea Project One and Hornsea Project Two, noting that this would place it on a similar passage to the already in use Immingham to Esbjerg adverse weather route, i.e. a route known to be considered safe for DFDS Seaways vessels operating in adverse weather. Therefore, although this adverse weather route may be impacted by the presence of the array, there is a safe and reasonable alternative. Moreover, with the low frequency of use, the impact is not expected to be present on a regular basis.

7.11.1.18 It is noted that none of the scenarios outlined above require a commercial ferry to make transit any closer to the Dogger Bank than is already the case – which is an area of particular sensitivity in adverse weather conditions given the navigation conditions which are considered a risk to navigational safety – and therefore there is no additional impact anticipated in relation to the Dogger Bank.

Increased encounters and vessel to vessel collision risk associated with third party vessels

7.11.1.19 The deviation of vessels due to the presence of the buoyed construction areas may result in an increased number of encounters between third party vessels and consequently an increase in the vessel to vessel collision risk.

7.11.1.20 When considering experience at other under construction offshore wind farms it is identified that third party vessels do consider Notifications to Mariners during passage planning and avoid areas of construction, likely passing greater than 1 nm off the buoyed construction area to keep clear of any ongoing construction activity. However, the extent to which the impact is present remains restricted to the area local to the Hornsea Four array area and HVAC booster station search area given the worst case deviations which have been assumed.

7.11.1.21 To date there have been no reported collision incidents involving a third party vessel within an offshore wind farm buoyed construction area.

7.11.1.22 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) in proximity to the Hornsea Four array area during the construction phase is considered moderate given the moderate volume of vessel traffic in the area compared to UK waters as a whole, although the consequences of most encounters are low, i.e. collision avoidance action implemented.

7.11.1.23 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) within the gap between Hornsea Four and Hornsea Project Two during the construction phase is considered low given the analysis of long-term AIS data undertaken. This data indicated a 2.5% probability of two or more vessels experiencing an encounter within the gap (further details are provided in Section 19.3 of **Volume A5, Annex 7.1: Navigational Risk Assessment**). The consequences of most encounters are again low, i.e. collision avoidance action implemented, noting that the 'bow tie' shape of the gap offers greater flexibility for vessels to make course adjustments than a formal navigational corridor with parallelogram shape. In the case of both encounters in proximity to the Hornsea Four array area and the gap, the duration for which the encounter (and collision) risk is present is the full construction phase, with the impact present only intermittently during this period given that third party vessels will not necessarily be present at all times.

7.11.1.24 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) in proximity to the Hornsea Four HVAC booster station search area is considered high given the high volume of vessel traffic in the area compared to UK waters as a whole, although an encounter would likely last for a limited time period given that no overarching restrictions on vessel routeing will be in place other than compliance with the International Regulations for Preventing Collisions at Sea (COLREGs) (IMO 1972/77) and as with the Hornsea Four array area the consequences of any encounter would likely be low. It is noted that the Hornsea Four HVAC booster station search area has been reduced in size by approximately 74% since the Scoping phase, with the main factor for this being to avoid the high density of vessel traffic at the original western extent of the original search area. This change significantly reduces the risk of a collision incident involving a third party vessel since disruption to the heavily trafficked commercial routes along the UK east coast is minimised.

7.11.1.25 It is expected that third party vessels will be compliant with Flag State regulations including IMO conventions such as the COLREGs, Safety of Life at Sea Convention (SOLAS) (IMO 1974) and guidance such as MGN 372 (MCA 2008). Taking this into account, along with the promulgation of information, experience at existing offshore wind farms of third party vessels adjusting passage plans to deviate around buoyed construction areas and sea room available there is not anticipated to be any significant increase in collision risk when considered alongside the commitments described in **Table 7.10**.

Increased encounters and vessel to vessel collision risk associated with construction vessels

7.11.1.26 The offshore construction phase may last up to three years and be undertaken in a single phase. Up to 6,126 return trips per year by construction vessels may be made. It is conservatively assumed that construction vessels will be on site throughout the construction phase and therefore the impact is of a continuous nature.

7.11.1.27 Encounters involving construction vessels for Hornsea Four are not considered likely given that movements will be fully managed by the MHCC. Moreover, construction vessels will have a traffic management plan that may include options such as entry and exit points into and out of the Hornsea Four array area. This will assist in preventing construction vessels exiting into a high density main route used by passing vessels, including through the gap between Hornsea Four and Hornsea Project Two.

7.11.1.28 The collision risk for construction vessels is likely to be greater in reduced visibility when the identification of construction vessels exiting/entering the Hornsea Four array area may be encumbered. However, the COLREGs (IMO 1972/77) regulates vessel movements in adverse weather conditions and requires all vessels operating in reduced visibility to reduce speed to allow more time for reacting to encounters, thus minimising the collision risk.

7.11.1.29 Taking this into account, as well as that construction vessels for Hornsea Four will be compliant with Flag State regulations including IMO conventions such as the COLREGs and guidance such as MGN 372 (MCA 2008), there is not anticipated to be any significant increase in collision risk.

Magnitude of impact

7.11.1.30 Overall, this impact is predicted to be of local spatial extent, short-term duration, continuous throughout the construction phase and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.11.1.31 The receptor is deemed to be generally not vulnerable, have good recoverability and low value, noting that commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.11.1.32 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however acknowledging the gap between Hornsea Four and Hornsea Project Two, the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

Pre-commissioned structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-C-2)

7.11.1.33 The presence of pre-commissioned structures on the perimeter of, or within, the Hornsea Four array area or HVAC booster station search area may increase the vessel to structure allision risk for powered and drifting vessels in an emergency situation (including machinery related problems and navigational system errors). The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and HVAC booster station search area given the need to be in proximity to a wind farm structure for an allision incident to occur.

Powered vessel to structure allision risk

7.11.1.34 When considering experience at other under construction offshore wind farms it is identified that third party vessels do consider Notifications to Mariners during passage planning and avoid areas of construction, typically passing greater than 1 nm off the buoyed construction area to keep clear of any ongoing construction activity. The buoyed construction area itself will likely consist of a combination of cardinal marks and special marks which will help ensure that vessels remain a safe distance from pre commissioned wind farm structures and hence reduce the risk of a powered allision incident. It is noted that it is likely that specialised aids to navigation will not be required for the gap between Hornsea Four and Hornsea Project Two, with the gap to be taken into consideration when establishing the buoyed construction area in liaison with Trinity House. The presence of operational aids to navigation post commissioning and increasing familiarity with the wind farm structures mean that the effect will have good recoverability.

7.11.1.35 It is noted that given the proximity to Hornsea Project One and Hornsea Project Two, it will be necessary to ensure there is no over proliferation of aids to navigation leading to confusion. Full consideration should be given to the use of lighting sequences such as different light characters and varied light ranges with this to be discussed with Trinity House post consent (see Section 23 of **Volume A5, Annex 7.1: Navigational Risk Assessment**).

7.11.1.36 Safety Zones will be applied for around active construction areas or pre-commissioned wind farm structures to ensure that those vessels (such as commercial fishing vessels) that do choose to navigate through the array area are aware of safe passing distances. It is noted that the minimum spacing of 810 m should be sufficient for small craft to make safe passage within the array. Guard vessels will also be present where necessary to offer local advice to mariners as required.

7.11.1.37 There have been no recorded incidents within UK waters associated with third party vessels experiencing a powered allision with a pre-commissioned wind farm structure and, although there have been incidents with construction vessels manoeuvring and alliding with a structure within a construction area, experience in the industry for developers, contractors and the vessel operators has and continue to increase operational procedures adopted as lessons are learnt.

7.11.1.38 In the case of an allision incident occurring, the level of damage a vessel sustains will depend upon the energy of impact, as well as the size and structural integrity of the vessel and the sea state at the time. Being smaller and with the possibility of having a non-steel

construction and the potential to navigate within the array, commercial fishing vessels and recreational vessels are likely to be most vulnerable to the impact.

7.11.1.39 During the construction phase, Hornsea Four construction areas shall be monitored by the MHCC located in Grimsby via Very High Frequency (VHF) radio and AIS but also through the presence of on site construction vessels. The Hornsea Four array area is in the majority out with the Global Maritime Distress and Safety System (GMDSS) sea area A1 and the presence of the MHCC, offshore VHF aerials, AIS receivers and the presence of on site construction vessels will mean a positive effect on communication, monitoring and SAR.

7.11.1.40 It is noted that the Hornsea Four HVAC booster station search area has been reduced in size by approximately 74% since the scoping phase, with the main factor contributing to this reduction being the avoidance of the high density of vessel traffic recorded at the western extent of the original search area. This change has significantly reduced the risk of an allision incident involving a third party vessel and an HVAC booster station since far fewer vessels will pass in close proximity to the under construction HVAC booster stations.

7.11.1.41 Should a vessel on site require assistance, then Hornsea Four, including under SOLAS (IMO 1974) obligations, are beneficially placed to provide assets including navigational information (including weather forecasting) and safety support. Taking this into consideration, as well as other commitments described in **Table 7.10**, the impact is not anticipated to be significant.

Drifting vessel to structure allision risk

7.11.1.42 Incident statistics (see Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms confirm that the frequency of machinery related failures in the area is very low and therefore the probability of a vessel being Not Under Command (NUC) in the area is also anticipated to be very low. This impact will only be present for a limited time and only when the direction of the wind or tide could cause the NUC vessel to drift within the array or in proximity to the HVAC booster stations.

7.11.1.43 Given this low frequency and the presence of the MHCC and increased resources/vessels on site at Hornsea Four during the construction phase that will be able to render assistance (including under SOLAS obligations), the impact is considered to be effectively managed.

Allision risk associated with oil and gas infrastructure

7.11.1.44 In addition to the wind farm structures creating a new allision risk to vessels, the re-routeing of vessel traffic introduces an allision risk associated with other surface infrastructure, in particular oil and gas surface platforms located in proximity to Hornsea Four. It is noted that this impact considers only the effect on shipping and navigation receptors (i.e. passing vessel traffic) with the effect on the oil and gas industry considered separately in **Chapter 11: Infrastructure and Other Users**.

7.11.1.45 With the main route deviations presented in **Figure 7.8** and **Figure 7.9** considered, the minimum distance between a main route and a surface platform is always greater than 1 nm. Given that vessels frequently pass within 1 nm of offshore infrastructure, it can be

inferred that there is sufficient sea room available for vessels to make the required deviations without being at high risk of an allision with a surface platform.

Magnitude of impact

7.11.1.46 Overall this impact is predicted to be of local spatial extent, short-term duration, continuous throughout the construction phase and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

7.11.1.47 The receptor is deemed to be generally not vulnerable, have good recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

7.11.1.48 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to Table 7.14, the effect could be either **neutral** or **slight** (which are both significant in EIA terms), however given the variable level of damage that a vessel may sustain from an allision impact, the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Pre-commissioned cables associated with the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels (SN-C-3)

7.11.1.49 The presence of pre-commissioned inter-array, interconnector and export cables could create an increased snagging risk for vessels navigating within the Hornsea Four array area and offshore ECC. The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and offshore ECC given the need to be in proximity to a cable for an anchor snagging incident to occur.

7.11.1.50 From the vessel traffic survey data, there was only one case of a vessel recorded anchoring within the Hornsea Four array area shipping and navigation study area throughout the vessel traffic surveys, this being a bulk carrier located approximately 1.7 nm east of the Hornsea Four array area. Given that the potential for a vessel to anchor in the Hornsea Four array area is low, impacts on vessels anchoring in proximity to the Hornsea Four array area are expected to be negligible.

7.11.1.51 From the vessel traffic survey data, there was only one case of a vessel anchoring within the Hornsea Four offshore ECC shipping and navigation study area throughout the vessel traffic surveys, this being a crude oil tanker in the nearshore area.

7.11.1.52 For the Hornsea Four offshore ECC, lessons learnt from other offshore wind farm developments show that anchoring has the potential to damage a subsea cable if a vessel drops its anchor on the cable or drags anchor over the cable. The damage caused depends on the penetration depth of the anchor (which itself depends on vessel size and type of anchor), the type of seabed and the cable burial depth or protection method.

7.11.1.53 "Planned" anchoring can take place for a number of reasons including adverse weather anchoring (e.g. seeking refuge in a safe haven), machinery failure (e.g. to slow drift speed/stop and/or to carry out repairs (e.g. loss of steering)) and subsea operations/survey vessels. It is noted that when the cable is being installed the probability of planned anchoring in close proximity is limited given that vessels will be aware (through Notification to Mariners, etc.) of the operations occurring.

7.11.1.54 Anchoring in an emergency situation (e.g. during steering failure) will be very low frequency; however it is noted that vessels may have limited time in which to decide to release and anchor if drifting towards a hazard. Promulgation methods will provide vessels with adequate information to make a decision and guard vessels will protect particularly vulnerable sections of cable or installation operations (following risk assessment).

7.11.1.55 With respect to vessels navigating within the gap between Hornsea Four and Hornsea Project Two, Regular Operators indicated during consultation that an "*extreme emergency*" would be necessary before dropping anchor within the gap and subsequently the likelihood of an anchor snagging incident (with either the one existing submarine cable within the gap is considered remote. Moreover, it is noted that no subsea cables relating to either Hornsea Four or Hornsea Project Two will be installed in the gap.

7.11.1.56 Any impacts associated with partially installed cables are expected to be mitigated by commitments included as part of Hornsea Four as described in **Table 7.10**.

7.11.1.57 There are not expected to be any effects on recreational vessels or smaller commercial fishing vessels given the water depths and penetration depths of their anchors which would limit the ability for them to snag an export, inter array or interconnector cable. Guard vessels monitoring vulnerable sections or operations are also able to assist small craft under SOLAS (IMO 1974) obligations.

Magnitude of impact

7.11.1.58 Overall this impact is predicted to be of local spatial extent, short-term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Significance of effect

7.11.1.59 Irrespective of the sensitivity of the receptor, the significance of the impact on all vessels is **not significant** as defined in the assessment of significance matrix (**Table 7.14**) and is therefore not considered further in this assessment.

Construction activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources (SN-C-4)

7.11.1.60 The construction of Hornsea Four, including the increased presence of vessels and personnel within the Hornsea Four array area and offshore ECC may impact upon the ability of emergency responders to respond to incidents. The MDS for vessel movements during the construction phase is up to eight construction vessels within a given 5 km^2 area with approximately three or four 5 km^2 areas at any given time with up to 6,126 return trips per year.

7.11.1.61 From recent SAR helicopter taskings data, the frequency of SAR operations in proximity to the Hornsea Four array area is moderate, although the majority of incidents occurred land side of the Hornsea Four array area and none occurred within the Hornsea Four array area itself. The frequency of SAR operations in proximity to the Hornsea Four HVAC booster station search area is low. The frequency of SAR helicopter taskings is not expected to change markedly given the self-help capabilities and emergency response which will be provided by Hornsea Four.

7.11.1.62 Further details pertaining to SAR helicopter taskings in proximity to Hornsea Four and details pertaining to the location of emergency response resources are provided in Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment.** Given the large area covered by emergency responders the extent of the impact is considered to be on a national level.

7.11.1.63 Given the increased presence of vessels and personnel on site during the construction phase there will be a small increase in the likelihood (frequency) of an incident occurring, which could diminish the overall ability of the current level of emergency response provision, including pollution response. In such a scenario the consequences could be high or very high.

7.11.1.64 However, under national and international law, the operators of Hornsea Four will be required to comply with the existing emergency response requirements of SOLAS (IMO 1974) as well as give consideration to other response groups within the area (MCA). Owing to the increased level of activity relating to Hornsea Four there would be expected to be some increased demands on SAR facilities within the area; however this would likely be mitigated by the presence of new on site resources (associated with the construction activities) that will be able to respond in an emergency (either related to Hornsea Four or a third party) under SOLAS obligations. Therefore, the likelihood of emergency response capability being compromised is considered to be low, even with the increased likelihood of an incident occurring.

7.11.1.65 Commitments included as part of Hornsea Four, which will help mitigate the impact on emergency response capability, are described in **Table 7.10**.

Magnitude of impact

7.11.1.66 Overall this impact is predicted to be of national spatial extent, short-term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

7.11.1.67 The receptor is deemed to be somewhat vulnerable, have very good recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effect

7.11.1.68 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **minor**. According to Table 7.14, the effect could be either **slight** or **moderate**, however given the positive effect the presence of new on site resources will have the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Future monitoring

7.11.1.69 The following monitoring requirements have been identified for the construction phase in relation to shipping and navigation:

- As per Co98 in Table 7.10, monitoring of vessel traffic for the duration of the construction period will be undertaken. Such monitoring is secured within the Deemed Marine Licence (DML) of the draft DCO.

7.11.2 Operation and Maintenance

7.11.2.1 The impacts of the offshore operation and maintenance of Hornsea Four have been assessed on shipping and navigation and are listed in Table 7.11 along with the MDS against which each impact has been assessed.

Presence of structures within the Hornsea Four array area, offshore ECC and HVAC booster station search area and activities associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore increased vessel to vessel collision risk for all vessels in all weather conditions (SN-O-5)

7.11.2.2 As noted for the equivalent construction phase impact, pre wind farm vessel traffic movements around the Hornsea Four array area, offshore ECC and HVAC booster station search area have been captured through dedicated vessel traffic surveys and AIS surveys as summarised in Section 7.6. Vessel traffic survey data assessments are considered alongside historical data (including the Anatec ShipRoutes database) thus ensuring that a detailed overview of vessel movements has been defined for use in the assessment of this impact. Additionally, the evolution of the baseline has been considered (see Section 7.7.4), primarily through consultation with Regular Operators.

7.11.2.3 It is noted that this impact considers only the risk to navigational safety due to vessel deviations rather than the risk to commercial operations, given that stakeholders clearly differentiated between the two forms of risk during consultation. The commercial impact of vessel deviations is assessed as a transboundary effect in Section 7.13.

Main route deviations

7.11.2.4 Main route deviations are as per the assessment of this effect for the construction phase given that, as described in the MGN 654 Shipping Route Template (MCA 2021), routes are assumed to maintain a minimum distance of 1 nm from the wind farm structures. This is a conservative assumption given that the distance at which vessels pass from the wind farm structures may be greater depending upon the sea room available and the prevailing conditions.

Adverse weather routeing

7.11.2.5 Effects on adverse weather routeing are as per the assessment of this effect for the construction phase given that the relevant deviations to routes are unchanged from the construction phase.

Increased encounters and vessel to vessel collision risk associated with third party vessels

7.11.2.6 With the main route deviations associated with the Hornsea Four array area in place, the associated annual vessel to vessel collision frequency for third party vessels is estimated to be 6.64×10^{-3}, corresponding to a collision return period of approximately one in 151 years. This represents a 14% increase in collision frequency compared to the base case pre wind farm scenario.

7.11.2.7 With the main route deviations associated with the Hornsea Four HVAC booster stations in place, the associated annual vessel to vessel collision frequency for third party vessels is estimated to be 6.00×10^{-3}, corresponding to a collision return period of approximately one in 168 years. This represents a 0.9% increase in collision frequency compared to the base case pre wind farm scenario.

7.11.2.8 To date there have been no reported collision incidents involving a third party vessel within an operational offshore wind farm.

7.11.2.9 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) in proximity to the Hornsea Four array area during the operational phase is considered high given the moderate volume of vessel traffic in the area compared to UK waters as a whole and the length of the operational phase. As with the construction phase, the consequences of most encounters are low, i.e. collision avoidance action implemented, with the extent to which the impact is present again restricted to the area local to the Hornsea Four array area given the worst case deviations which have been assumed.

7.11.2.10 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) within the gap between Hornsea Four and Hornsea Project Two during the operational phase is considered low given the analysis of long-term AIS data undertaken. This data indicated a 2.5% probability of two or more vessels experiencing an encounter within the gap (further details are provided in Section 19.3 of **Volume A5, Annex 7.1: Navigational Risk Assessment**). The consequences of most encounters are again low, i.e. collision avoidance action implemented, noting that the 'bow tie' shape of the gap offers greater flexibility for vessels to make course adjustments than a formal navigational corridor with parallelogram shape. In the case of both encounters in

proximity to the Hornsea Four array area and the gap, the impact is present only intermittently during the operational phase given that third party vessels will not always necessarily be present.

7.11.2.11 The likelihood of an encounter in proximity to the Hornsea Four HVAC booster station search area is considered very high given the high volume of vessel traffic in the area compared to UK waters as a whole, and the length of the operational phase, although an encounter would likely last for a limited time period given that no overarching restrictions on vessel routeing will be in place other than compliance with the COLREGs (IMO 1972/77) and as with the Hornsea Four array area the consequences of any encounter would likely be low. It is noted that the Hornsea Four HVAC booster station search area has been reduced in size by approximately 74% since the Scoping phase, with the main factor for this being to avoid the high density of vessel traffic at the western extent of the original search area. This change significantly reduces the risk of a collision incident involving a third party vessel since disruption to the heavily trafficked commercial routes along the UK east coast is minimised.

7.11.2.12 It is expected that third party vessels will be compliant with Flag State regulations including IMO conventions such as the COLREGs, SOLAS (IMO 1974) and guidance such as MGN 372 (MCA 2008). Taking this into account, along with the promulgation of information, experience at existing offshore wind farms of third party vessels adjusting passage plans to deviate around operational offshore wind farms and sea room available there is not anticipated to be any significant increase in collision risk when considered alongside the commitments described in **Table 7.10**.

Increased encounters and vessel to vessel collision risk associated with operation and maintenance vessels

7.11.2.13 The operational phase may last up to 35 years. Up to 1,433 return trips per year by operation and maintenance vessels may be made. Given that operation and maintenance vessels will make regular visits to Hornsea Four but may not necessarily always be present, the impact is considered to be of an intermittent nature.

7.11.2.14 As with the construction phase, encounters involving operation and maintenance vessels for Hornsea Four are not considered likely given that movements will be fully managed by the MHCC. Vessels will be subject to a traffic management plan that may include options such as entry and exit points into and out of the Hornsea Four array area. This will assist in preventing operation and maintenance vessels exiting into a high density main route used by passing vessels, including through the gap between Hornsea Four and Hornsea Project Two.

7.11.2.15 The collision risk for operation and maintenance vessels is likely to be greater in reduced visibility when the identification of operations and maintenance vessels exiting/entering the Hornsea Four array area may be encumbered. However, the COLREGs (IMO 1972/77) regulates vessel movements in adverse weather conditions and requires all vessels operating in reduced visibility to reduce speed to allow more time for reacting to encounters, thus minimising the collision risk.

7.11.2.16 Although the number of visits to the Hornsea Four array area by project vessels will be significantly less during the operation and maintenance phase than the construction phase there is a greater possibility of third party vessels being present within the array and therefore a risk to operation and maintenance vessels of a collision. However, from consultation with Regular Operators and experience of existing offshore wind farms it is anticipated that commercial vessels (cargo vessels, tankers, passenger vessels etc.) will choose not to transit within the array.

7.11.2.17 Only smaller craft such as recreational vessels and fishing vessels are likely to enter the array. Throughout the vessel traffic surveys an average of one unique recreational vessel every three to four days passed within the Hornsea Four array area shipping and navigation study area, with only four transits passing through the array area itself. An average of one to two unique commercial fishing vessels per day passed within the Hornsea Four array area shipping and navigation study area, with an average of only one commercial fishing vessel every two days within the array area itself.

7.11.2.18 Given the low level of small craft activity in proximity to the Hornsea Four array area and the likely experience of Mariners operating at the distance offshore which Hornsea Four is located, the likelihood of an encounter involving an operation and maintenance vessel is considered to be low.

7.11.2.19 Taking this into account, as well as that operation and maintenance vessels for Hornsea Four will be compliant with Flag State regulations including IMO conventions such as the COLREGs and guidance such as MGN 372 (MCA 2008), there is not anticipated to be any significant increase in collision risk.

Increased encounters and vessel to vessel collision risk associated with third party vessels exiting the Hornsea Four array area

7.11.2.20 In addition to the collision risk due to the presence of operation and maintenance vessels within the array, there is a collision risk associated with smaller craft exiting the Hornsea Four array area, noting that such vessels may experience an impairment to their visual navigation due to the wind farm structures, as identified in MGN 654 (MCA 2021). This includes collision risk associated with smaller craft crossing the gap between Hornsea Four and Hornsea Project Two.

7.11.2.21 The levels of small craft likely to be operating within the array or in proximity to the main commercial routes is low, and in particular the higher density areas of small craft activity are generally at a distance great enough from the array area that any user of the gap should be able to safely make course alterations as required (with the bow tie shape of the gap assisting with the detection of smaller craft crossing). Therefore, the frequency of encounters and thus collision risk involving third party vessels exiting the Hornsea Four array area is low. Furthermore, the application of the COLREGs (IMO 1972/77) by such vessels should mitigate the impact by regulating all vessels to operate at a safe speed and use sound signals to notify others of their presence.

Magnitude of impact

7.11.2.22 Overall this impact is predicted to be of local spatial extent, medium-term duration, intermittent and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **moderate**.

Sensitivity of the receptor

7.11.2.23 The receptor is deemed to be generally not vulnerable, have good recoverability and low value, noting that commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.11.2.24 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **moderate**. The effect will, therefore, be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

Operational structures within the Hornsea Four array area and HVAC booster station search area may create powered and drifting allision risk for all vessels (SN-O-6)

7.11.2.25 The presence of operational structures on the perimeter of, or within, the Hornsea Four array area or HVAC booster station search area may increase the vessel to structure allision risk for powered and drifting vessels in an emergency situation (including machinery related problems and navigational system errors). The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and HVAC booster station search area given the need to be in proximity to a wind farm structure for an allision incident to occur.

Powered vessel to structure allision risk

7.11.2.26 Hornsea Four will potentially be the fourth offshore wind farm within the former Hornsea Zone; when considering this along with the other under construction or operational offshore wind farms within the UK Renewable Energy Zone (REZ) it is noted that vessels are familiar with navigation in proximity to WTGs.

7.11.2.27 With the main route deviations associated with the Hornsea Four array area in place, the associated annual powered vessel to structure allision frequency is estimated to be 1.08×10^{-3}, corresponding to an allision return period of approximately one in 929 years. The highest individual allision risk was associated with structures on the southern boundary of the array area and the northern boundary of Hornsea Project Two where a number of routes pass with a closest point of approach (CPA) of 1 nm. The highest individual allision risk was associated with the structure on the southern corner of the Hornsea Four array area (approximately 1.86×10^{-4} or one in 5,400 years).

7.11.2.28 The width of the gap between Hornsea Four and Hornsea Project Two (2.2 nm measured centre-to-centre) is sufficient to allow vessels to pass through and maintain a safe distance from structures on both sides, noting that no specific navigational safety concerns were raised by consultees during the second Hazard Workshop (where the gap was the main topic of discussion).

7.11.2.29 To date there has only been one incident of a third party vessel alliding with an operational WTG. In this case a crew member on a fishing vessel left the autopilot on, resulting in an allision incident which was attended by an RNLI lifeboat.

7.11.2.30 As with the construction phase, in the case of an allision incident occurring the level of damage a vessel sustains will depend upon the energy of impact, as well as the size and structural integrity of the vessel and the sea state at the time. Being smaller and with the possibility of having a non-steel construction and the potential to navigate within the array, commercial fishing vessels and recreational vessels are likely to be most vulnerable to the impact.

7.11.2.31 Offshore transformer substations, offshore HVDC converter substations and the accommodation platform present an increased allision risk to vessels due to the greater size and resistant force of the structure compared to the energy of the impact. This will be taken into consideration as part of the final layout design, noting that as part of the MDS some of these structures have been placed on the periphery of the array, although it is assumed that no such structures will be placed on the periphery that lines the gap between Hornsea Four and Hornsea Project Two (see Section 9 of **Volume A5, Annex 7.1: Navigational Risk Assessment**). Realistically these structures are unlikely to be placed on the periphery at all but if they are (excluding the periphery that lines the gap) then it is not anticipated that they will increase the allision risk to intolerable severity levels and can be mitigated with effective lighting and marking (marking and lighting in accordance with standard industry guidance and regulatory requirements – Commitment Co93 (see **Section 7.8.2**) and in line with IALA Recommendation O-139 (IALA 2013)).

7.11.2.32 The HVAC booster stations also present an increased allision risk to vessels compared to WTGs for similar reasons. It is noted that the Hornsea Four HVAC booster station search area has been reduced in size by approximately 74% since the Scoping phase, with the main factor for this being to avoid the high density of vessel traffic at the western extent of the original search area. This change significantly reduced the risk of an allision incident involving a third party vessel and an HVAC booster station since much fewer vessels will pass in close proximity to the HVAC booster stations and so the likelihood of an errant vessel under power deviating from its route to the extent that it comes into proximity with an HVAC booster station is considered to be low.

7.11.2.33 With the main route deviations associated with the Hornsea Four HVAC booster stations in place for indicative HVAC booster station locations (as presented in Section 9 of **Volume A5, Annex 7.1: Navigational Risk Assessment**), the associated annual powered vessel to structure allision frequency is estimated to be 1.05×10^{-3}, corresponding to an allision return period of approximately one in 948 years. The highest individual allision risk was associated with the western structure (approximately 5.52×10^{-4} or one in 1,810 years) which is closest to a number of heavily trafficked main routes, including the two routes deviated due to the presence of the HVAC booster stations.

7.11.2.34 No fishing or recreational users expressed any concerns in relation to the HVAC booster stations.

7.11.2.35 As with the construction phase, should a vessel on site require assistance then Hornsea Four, including under SOLAS (IMO 1974) obligations, are beneficially placed to provide assets including navigational information (including weather forecasting) and safety support. Taking this into consideration, as well as other commitments described in **Table 7.10**, the impact is not anticipated to be significant.

Drifting vessel to structure allision risk

7.11.2.36 Incident statistics (see Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms all confirm that the frequency of machinery related failures in the area is very low and therefore the probability of a vessel being NUC in the area is also anticipated to be very low. This impact will only be present for a limited time and only when the direction of the wind or tide could cause the NUC vessel to drift within the array or in proximity to the HVAC booster stations.

7.11.2.37 Given this low frequency and the presence of the MHCC and increased resources/vessels on site at Hornsea Four during the operational phase (even if not to the same degree as during the construction phase) able to render assistance (including under SOLAS obligations), the impact is considered to be effectively managed.

7.11.2.38 With the main route deviations associated with the Hornsea Four array area in place, the associated annual drifting vessel to structure allision frequency is estimated to be 1.16×10^{-3}, corresponding to an allision return period of approximately one in 866 years. The highest individual allision risk was associated with structures on the southern boundary of the array area where a number of routes pass with a CPA of 1 nm. The highest individual allision risk was associated with the structure on the southern boundary at the narrowest point of the gap between Hornsea Four and Hornsea Project Two (approximately 1.82×10^{-4} or one in 5,480 years).

7.11.2.39 Should a vessel become NUC whilst navigating within the gap between Hornsea Four and Hornsea Project Two then it is considered likely that the vessel would initiate its own emergency response procedures which would most likely involve emergency anchoring noting that the potential for this based on consultation undertaken and historical incident statistics is very low. Therefore, the likelihood of an allision incident for an NUC vessel is remote.

7.11.2.40 With the main route deviations associated with the Hornsea Four HVAC booster stations in place, the associated annual drifting vessel to structure allision frequency is estimated to be 4.52×10^{-5}, corresponding to an allision return period of approximately one in 22,100 years. The highest individual allision risk was associated with the western structure (approximately 2.93×10^{-5} or one in 34,100 years) which is closest to a number of heavily trafficked main routes, including the one route deviated due to the presence of the HVAC booster stations.

7.11.2.41 In the case that a drifting allision incident occurs, it is likely that it would occur at low speed, thus reducing the consequences of any impact. As with powered allision incidents the size and structural integrity of the vessel and the sea state at the time will also be contributing factors.

Internal allision risk

7.11.2.42 Based on consultation feedback from Regular Operators (see consultation with DFDS Seaways in **Section 7.4**) and past experience it is not considered likely that larger commercial vessels will navigate within the array; the predominant users are expected to be smaller craft such as recreational vessels and fishing vessels. The level of small craft within the area is very low and is not expected to increase significantly in a future case scenario.

7.11.2.43 The annual vessel to structure collision frequency for commercial fishing vessels is estimated to be 4.42×10^{-2}, corresponding to a collision return period of approximately one in 23 years. This is a low frequency when compared to other allision assessments carried out on developments in UK waters. Additionally, the model does not assume the magnitude of any allision incident, and as noted above the consequences of any impact are also likely to be low.

7.11.2.44 The single line of orientation included in the array layout will assist with safe internal navigation, noting that historical data shows that vessels transiting through offshore wind farms tend to do so in straight lines between waypoints but not necessarily following any designated line of orientation (i.e. a specific row or column); instead they will often take the shortest route. This is supported by consultation with fishing stakeholders which indicated that fishermen are first and foremost likely to follow the features of the seabed before taking into consideration the layout of wind farm structures (see consultation undertaken as part of **Chapter 6: Commercial Fisheries**.

7.11.2.45 As with any passage, movements within the array will depend upon the prevailing conditions and vessels are expected to passage plan accordingly in line with Chapter V of SOLAS (IMO 1974). Given the distance offshore it is anticipated that any small craft choosing to navigate internally within the array will be well equipped and experienced.

7.11.2.46 During periods of major maintenance, Safety Zones will be applied for around active maintenance areas to ensure that those vessels that choose to navigate through the array are aware of safe passing distances. It is noted that the minimum spacing of 810 m should be sufficient for small craft to make safe passage within the array. Also, should a vessel navigate directly between Hornsea Four and Hornsea Project One and/or Hornsea Project Two, there should be no additional internal allision risk given that the minimum spacing at Hornsea Project One and Hornsea Project Two is also at least 810 m and those developments also incorporate a single line orientation in their respective layouts.

Allision risk associated with oil and gas infrastructure

7.11.2.47 In addition to the wind farm structures creating an allision risk to vessels, the re-routeing of vessel traffic introduces an allision risk associated with other surface infrastructure, in particular oil and gas surface platforms located in proximity to Hornsea Four. It is noted that this impact considers only the effect on shipping and navigation receptors (i.e. passing vessel traffic) with the effect on the oil and gas industry considered separately in **Chapter 11: Infrastructure and Other Users**.

7.11.2.48 With the main route deviations presented in **Figure 7.8** and **Figure 7.9** considered, the minimum distance between a main route and a surface platform is always greater than 1 nm. Given that vessels frequently pass within 1 nm of offshore infrastructure, it can be inferred that there is sufficient sea room available for vessels to make the required deviations without being at high risk of an allision with a surface platform.

Magnitude of impact

7.11.2.49 Overall this effect is predicted to be of local spatial extent, medium-term duration, continuous throughout the operational phase and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

7.11.2.50 The receptor is deemed to be generally not vulnerable, have good recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

7.11.2.51 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however given the variable level of damage that a vessel may sustain from an allision impact, the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Operational cables within the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels and cable protection used may reduce navigable water depths for all vessels (SN-O-7)

7.11.2.52 The presence of operational inter-array, interconnector and export cables could create an increased snagging risk for vessels navigating within the Hornsea Four array area and offshore ECC. The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and offshore ECC given the need to be in proximity to a cable for an anchor snagging incident to occur.

Anchor snagging risk

7.11.2.53 Vessel anchoring activity is considered in **Section 7.7.2** and is very low both in proximity to the Hornsea Four array area and offshore ECC.

7.11.2.54 Given that any cable (export, inter-array or interconnector) will be buried and/or protected as well as charted there are not anticipated to be any perceptible effects on vessels during the operational phase. Commitments included as part of Hornsea Four are described in **Table 7.10**.

7.11.2.55 As with the construction phase, lessons learnt from other offshore wind farm developments show that anchoring has the potential to damage a subsea cable if a vessel drops its anchor on the cable or drags anchor over the cable.

7.11.2.56 Anchoring in an emergency situation (e.g. during steering failure) will be very low frequency; however it is noted that vessels may have limited time in which to decide to release and anchor if drifting towards a hazard. Therefore the cable specification, installation and monitoring plan will also set out burial depths or protection methods used to mitigate any risk with unexpected anchor releases.

7.11.2.57 With respect to vessels navigating within the gap between Hornsea Four and Hornsea Project Two, Regular Operators indicated during consultation that an "*extreme emergency*" would be necessary before dropping anchor within the gap and subsequently the likelihood of an anchor snagging incident (is considered remote. Moreover, it is noted that no subsea cables relating to either Hornsea Four or Hornsea Project Two will be installed in the gap.

7.11.2.58 There are not expected to be any effects on recreational vessels or smaller commercial fishing vessels given the water depths and penetration depths of their anchors which would limit the ability for them to snag an export, inter array or interconnector cable. In the case that an anchor snagging incident does occur, the consequences are most likely minor.

Under keel allision risk

7.11.2.59 Guidance noted within MGN 654 (see Commitment Co81) states that where protection is used it should not change the charted water depth by more than 5%; RYA guidance (RYA 2019) states that clearance distances of over 4 m are not a concern. Should either of these parameters not be achieved further assessment and consultation may be required as part of the post consent process. Consequences for under keel allision can be significant but Hornsea Four is committed to compliance with relevant guidance as part of the cable specification, installation and monitoring plan.

Magnitude of impact

7.11.2.60 Overall this impact is predicted to be of local spatial extent, medium-term duration, intermittent and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

7.11.2.61 The receptor is deemed to be generally not vulnerable, have very good recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

7.11.2.62 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to Table 7.14, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however given that cable burial and protection will serve to largely eliminate the impact the effect is considered to be of **neutral** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Operation and maintenance activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources (SN-O-8)

7.11.2.63 The operation and maintenance of Hornsea Four may impact upon the ability of emergency responders to respond to incidents. The MDS for vessel movements during the operational phase is up to 1,433 return trips per year.

7.11.2.64 Given that vessel, aircraft and personnel numbers will be significantly reduced during the operational phase (compared to the construction phase) there are not anticipated to be any significant impacts on emergency response resources during the operation and maintenance phase given that all offshore operations will have their own self-help capability as part of their emergency response plans.

7.11.2.65 It is of note that Hornsea Four on site facilities will have beneficial impacts on emergency response provision for all users.

7.11.2.66 From recent SAR helicopter taskings data, the frequency of SAR operations in proximity to the Hornsea Four array area is moderate, although the majority of incidents occurred land side of the Hornsea Four array area and none occurred within the Hornsea Four array area itself. The frequency of SAR operations in proximity to the Hornsea Four HVAC booster station search area is low. The frequency of SAR helicopter taskings is not expected to change markedly given the self-help capabilities and emergency response which will be provided by Hornsea Four.

7.11.2.67 Further details pertaining to SAR helicopter taskings in proximity to Hornsea Four and details pertaining to the location of emergency response resources are provided in Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**. Given the large area covered by emergency responders the extent of the impact is considered to be on a national level.

7.11.2.68 Given the increased presence of vessels and personnel on site during the operational phase there will be a small increase in the likelihood (frequency) of an incident occurring, which could diminish the overall ability of the current level of emergency response provision, including pollution response. In such a scenario the consequences could be high or very high.

7.11.2.69 However, under national and international law, the operators of Hornsea Four would be required to comply with the existing emergency response requirements of SOLAS (IMO 1974) as well as give consideration to other response groups within the area (MCA). Owing to the increased level of activity relating to Hornsea Four there would be expected to be some increased demands on SAR facilities within the area; however this would likely be mitigated by the presence of new on site resources (associated with the operation and maintenance activities) that will be able to respond in an emergency (either related to Hornsea Four or a third party) under SOLAS obligations. Therefore, the likelihood of emergency response capability being compromised is considered to be low, even with the increased likelihood of an incident occurring.

7.11.2.70 Commitments included as part of Hornsea Four, which will help mitigate the impact on emergency response capability, are described in **Table 7.10** and include the agreement of Layout Principles which are designed to assist with ensuring acceptable SAR access within the array.

Magnitude of Impact

7.11.2.71 Overall this impact is predicted to be of national spatial extent, medium-term duration, intermittent and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

7.11.2.72 The receptor is deemed to be generally not vulnerable, have good recoverability and high value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of effect

7.11.2.73 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **slight** or **moderate**, however given the positive effect the presence of new on site resources will have the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Operational structures within the Hornsea Four array area and offshore ECC may impact a vessel's use of its Radar, communications and navigation equipment during navigational transits (SN-O-9).

7.11.2.74 Section 17 of **Volume A5, Annex 7.1: Navigational Risk Assessment** includes a detailed technical assessment of effects associated with the impact on communications and position fixing equipment associated with the operation of the Hornsea Four array area, offshore ECC and HVAC booster station search area. The results are summarised in **Table 7.17**.

Table 7.17: Summary of significance and magnitude by type of communication or navigation equipment.

Topic		Sensitivity	Magnitude
Type	Specific		
Communication	VHF	Low	Negligible
Communication	VHF direction finding	Low	Negligible
Communication	AIS	Low	Negligible
Communication	Navigational Telex (NAVTEX)	Low	Negligible
Communication	Global Positioning System (GPS)	Low	Negligible
EMF	Cables	Low	Negligible
EMF	WTGs	Negligible	Negligible
Marine Radar	Use of marine Radar	Medium	Negligible
Noise	WTG generated noise	Low	Negligible
Noise	Sound Navigation Ranging (SONAR)	Low	Negligible

7.11.2.75 In the case of marine Radar the sensitivity is defined as medium, noting in particular that for vessels transiting through the gap between Hornsea Four and Hornsea Project Two there may be a potential for increased exposure to Radar interference. However, taking into account the bow tie shape of the gap, the duration of such a transit for which the distance from WTGs will be less than 1.5 nm (the onset range of false returns based on MGN 654 (MCA 2021)) will be low.

7.11.2.76 Elsewhere in proximity to the Hornsea Four array area, vessels have sufficient sea room to distance themselves from the array area, in line with the Shipping Route Template (MCA 2021) and experience shows that careful adjustment of controls and compliance with the COLREGs (IMO 1972/77) mitigates any impacts for those navigating in close proximity (including within the gap) or internally within the array.

7.11.2.77 Given the experience gained from offshore wind farms being constructed in close proximity to shipping activity all effects are considered to be ALARP and no further commitments are required.

Significance of effect

7.11.2.78 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **negligible**. The effect will, therefore, be of **neutral** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

7.11.3 Decommissioning

Decommissioning activities associated with the Hornsea Four array area and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-D-10)

7.11.3.1 As noted for the equivalent construction and operational phase impacts, pre wind farm vessel traffic movements around the Hornsea Four array area, offshore ECC and HVAC booster station search area have been captured through dedicated vessel traffic surveys and AIS surveys as summarised in **Section 7.7**. Vessel traffic survey data assessments are considered alongside historical data (including the Anatec ShipRoutes database) thus ensuring that a detailed overview of vessel movements has been defined for use in the assessment of this impact. Additionally, the evolution of the baseline has been considered (see **Section 7.7.4**), primarily through consultation with Regular Operators.

7.11.3.2 It is noted that this impact considers only the risk to navigational safety due to vessel deviations rather than the risk to commercial operations, given that stakeholders clearly differentiated between the two forms of risk during consultation. The commercial impact of vessel deviations is assessed as a transboundary effect in **Section 7.13**.

Main route deviations

7.11.3.3 Main route deviations are as per the assessment of this effect for the construction phase given that the buoyed decommissioning area is considered to be comparable to the buoyed construction area.

Adverse weather routeing

7.11.3.4 Effects on adverse weather routeing are as per the assessment of this effect for the construction phase given that the relevant deviations to routes are unchanged from the construction phase.

Increased encounters and vessel to vessel collision risk associated with third party vessels

7.11.3.5 The deviation of vessels due to the presence of the buoyed decommissioning areas may result in an increased number of encounters between third party vessels and consequently an increase in the vessel to vessel collision risk.

7.11.3.6 The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and HVAC booster station search area given the worst case deviations which have been assumed.

7.11.3.7 To date there have been no reported collision incidents involving a third party vessel within an offshore wind farm buoyed construction area, noting the similar nature of a buoyed decommissioning area.

7.11.3.8 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) in proximity to the Hornsea Four array area during the decommissioning phase is considered moderate given the moderate volume of vessel traffic in the area compared to UK waters as a whole, although the consequences of most encounters are low, i.e. collision avoidance action implemented.

7.11.3.9 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) with the gap between Hornsea Four and Hornsea Project Two during the decommissioning phase is considered low given the analysis of long-term AIS data undertaken. This data indicated a 2.5% probability of two or more vessels experiencing an encounter within the gap (further details are provided in Section 19.3 of **Volume A5, Annex 7.1: Navigational Risk Assessment**). The consequences of most encounters are again low, i.e. collision avoidance action implemented, noting that the 'bow tie' shape of the gap offers greater flexibility for vessels to make course adjustments than a formal navigational corridor with parallelogram shape. In the case of both encounters in proximity to the Hornsea Four array area and the gap, the duration for which the encounter (and collision) risk is present is the full decommissioning phase, with the impact present only intermittently during this period given that third party vessels will not always necessarily be present at all times.

7.11.3.10 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) in proximity to the Hornsea Four HVAC booster station search area is considered high given the high volume of vessel traffic in the area compared to UK waters as a whole, although an encounter would likely last for a limited time period given that no overarching restrictions on vessel routeing would be in place other than compliance with the COLREGs (IMO 1972/77) and as with the Hornsea Four array area the consequences of any encounter would likely be low. It is noted that the Hornsea Four HVAC booster station search area has been reduced in size by approximately 74% since the Scoping phase, with the main factor for this being to avoid the high density of vessel traffic at the western extent of the original search area. This change significantly reduces the risk of a collision incident involving a third party vessel since disruption to the heavily trafficked commercial routes along the UK east coast is minimised.

7.11.3.11 It is expected that third party vessels will be compliant with Flag State regulations including IMO conventions such as the COLREGs, SOLAS (IMO 1974) and guidance such as MGN 372 (MCA 2008). Taking this into account, along with the promulgation of information, experience at existing offshore wind farms of third party vessels adjusting passage plans to deviate around buoyed construction areas (noting the similar nature of a buoyed decommissioning area) and sea room available there is not anticipated to be any significant increase in collision risk when considered alongside the commitments described in **Table 7.10**.

Increased encounters and vessel to vessel collision risk associated with decommissioning vessels

7.11.3.12 The decommissioning phase may last up to three years and be undertaken in a single phase. Up to 6,126 return trips per year by decommissioning vessels may be made. It is conservatively assumed that decommissioning vessels will be on site throughout the decommissioning phase and therefore the impact is of a continuous nature.

7.11.3.13 Encounters involving decommissioning vessels for Hornsea Four are not considered likely given that movements will be fully managed by the MHCC. Moreover, vessels will have a traffic management plan that may include options such as entry and exit points into and out of the Hornsea Four array area. This will assist in preventing decommissioning vessels exiting into a high-density main route used by passing vessels, including through the gap between Hornsea Four and Hornsea Project Two.

7.11.3.14 The collision risk for decommissioning vessels is likely to be greater in reduced visibility when the identification of decommissioning vessels exiting/entering the Hornsea Four array area may be encumbered. However, the COLREGs (IMO 1972/77) regulates vessel movements in adverse weather conditions and requires all vessels operating in reduced visibility to reduce speed to allow more time for reacting to encounters, thus minimising the collision risk.

7.11.3.15 Taking this into account, as well as that decommissioning vessels for Hornsea Four will be compliant with Flag State regulations including IMO conventions such as the COLREGs and guidance such as MGN 372 (MCA 2008), there is not anticipated to be any significant increase in collision risk.

Magnitude of impact

7.11.3.16 Overall this impact is predicted to be of local spatial extent, short-term duration, continuous throughout the decommissioning phase and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.11.3.17 The receptor is deemed to be generally not vulnerable, have good recoverability and low value, noting that commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.11.3.18 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however acknowledging the gap between Hornsea Four and Hornsea Project Two, the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

Decommissioning structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-D-11).

7.11.3.19 The presence of decommissioning structures on the perimeter of, or within, the Hornsea Four array area or HVAC booster station search area may increase the vessel to structure allision risk for powered and drifting vessels in an emergency situation (including machinery related problems and navigational system errors). The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and HVAC booster station search area given the need to be in proximity to a wind farm structure for an allision incident to occur.

Powered vessel to structure allision risk

7.11.3.20 When considering experience at under construction offshore wind farms it is identified that third party vessels do consider Notifications to Mariners during passage planning and avoid areas of construction, likely passing greater than 1 nm off the buoyed construction area to keep clear of any ongoing construction activity. Buoyed decommissioning areas are expected to be treated by third party vessels similarly to buoyed construction areas. The buoyed decommissioning area itself will likely consist of a combination of cardinal marks and special marks which will help ensure that vessels remain a safe distance from decommissioning wind farm structures and hence reduce the risk of a powered allision incident. It is noted that it is likely that specialised aids to navigation will not be required for the gap between Hornsea Four and Hornsea Project Two, with the gap to be taken into consideration when establishing the buoyed decommissioning area in liaison with Trinity House. The decreasing number of wind farm structures in place as the decommissioning phase progresses and the lack of any surface structures in situ post decommissioning mean that the impact will be reversible.

7.11.3.21 Safety Zones will be applied for around active decommissioning areas to ensure that those vessels (such as fishing vessels) that do choose to navigate through the array are aware of safe passing distances. It is noted that the minimum spacing of 810 m should be sufficient for small craft to make safe passage within the array. Guard vessels will also be present to offer local advice to mariners as required.

7.11.3.22 There have been no recorded incidents within UK waters associated with third party vessels experiencing a powered allision with a pre-commissioned wind farm structure and, although there have been incidents with construction vessels manoeuvring and alliding with a structure at low speed within a construction area, experience in the industry for developers, contractors and the vessel operators has and continue to increase operational procedures adopted as lessons are learnt. Given the similar nature of decommissioning works to construction, this information is considered relevant to the decommissioning phase.

7.11.3.23 In the case of an allision incident occurring, the level of damage a vessel sustains will depend upon the energy of impact, as well as the size and structural integrity of the vessel and the sea state at the time. Being smaller and with the possibility of having a non-steel construction and the potential to navigate within the array, fishing vessels and recreational vessels are likely to be most vulnerable to the impact.

7.11.3.24 During the decommissioning phase, Hornsea Four decommissioning areas shall be monitored by the MHCC located in Grimsby via VHF radio and AIS but also through the presence of on-site decommissioning vessels. As with the construction phase the presence of the MHCC, offshore VHF aerials, AIS receivers and the presence of on-site decommissioning vessels will mean a positive impact for communication, monitoring and SAR.

7.11.3.25 It is noted that the Hornsea Four HVAC booster station search area has been reduced in size by approximately 74% since the Scoping phase, with the main factor for this being to avoid the high density of vessel traffic at the western extent of the original search area. This change significantly reduced the risk of an allision incident involving a third party vessel and an HVAC booster station since much fewer vessels will pass in close proximity to the decommissioning HVAC booster stations.

7.11.3.26 Should a vessel on site require assistance, then Hornsea Four, including under SOLAS (IMO 1974) obligations, are beneficially placed to provide assets including navigational information (including weather forecasting) and safety support. Taking this into consideration, as well as other commitments described in **Table 7.10**, the impact is not anticipated to be significant.

Drifting vessel to structure allision risk

7.11.3.27 Incident statistics (see Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms confirm that the frequency of machinery related failures in the area is very low and therefore the probability of a vessel being NUC in the area is also anticipated to be very low. This impact will only be present for a limited time and only when the direction of the wind or tide could cause the NUC vessel to drift within the array or in proximity to the HVAC booster stations.

7.11.3.28 Given this low frequency and the presence of the MHCC and increased resources/vessels on site at Hornsea Four during the decommissioning phase that will be able to render assistance (including under SOLAS obligations), the impact is considered to be effectively managed.

Allision risk associated with oil and gas infrastructure

7.11.3.29 In addition to the wind farm structures creating an allision risk to vessels, the re-routeing of vessel traffic introduces an allision risk associated with other surface infrastructure, in particular oil and gas surface platforms located in proximity to Hornsea Four. It is noted that this impact considers only the effect on shipping and navigation receptors (i.e. passing vessel traffic) with the effect on the oil and gas industry considered separately in **Chapter 11: Infrastructure and Other Users**.

7.11.3.30 With the main route deviations presented in **Figure 7.8** and **Figure 7.9** considered, the minimum distance between a main route and a surface platform is always greater than 1 nm. Given that vessels frequently pass within 1 nm of offshore infrastructure, it can be inferred that there is sufficient sea room available for vessels to make the required deviations without being at high risk of an allision with a surface platform.

Magnitude of impact

7.11.3.31 Overall this impact is predicted to be of local spatial extent, short-term duration, continuous throughout the decommissioning phase and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of receptor

7.11.3.32 The receptor is deemed to be generally not vulnerable, have good recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

7.11.3.33 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both significant in EIA terms), however given the variable level of damage that a vessel may sustain from an allision impact, the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Decommissioned cables left in situ within the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels (SN-D-12)

7.11.3.34 The presence of decommissioned inter-array, interconnector and export cables left in situ could create an increased snagging risk for vessels navigating within the Hornsea Four array area and offshore ECC. The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and offshore ECC given the need to be in proximity to a cable for an anchor snagging incident to occur, although since the cables will be present indefinitely, the impact is considered to be of long-term duration.

7.11.3.35 Vessel anchoring activity is considered in **Section 7.7.2** and is very low both in proximity to the Hornsea Four array area and offshore ECC.

7.11.3.36 As part of the decommissioning phase, cables will be subject to a risk assessment and monitoring procedures. By this phase of the development, vessels will be familiar with the locations of the charted cables, although any cables left in situ would be present indefinitely.

7.11.3.37 Anchoring in an emergency situation (e.g. during steering failure) will be very low frequency; however it is noted that vessels may have limited time in which to decide to release and anchor if drifting towards a hazard.

7.11.3.38 With respect to vessels navigating within the gap between Hornsea Four and Hornsea Project Two, Regular Operators indicated during consultation that an "*extreme emergency*" would be necessary before dropping anchor within the gap and subsequently the likelihood of an anchor snagging incident is considered remote. Moreover, it is noted that no subsea cables relating to either Hornsea Four or Hornsea Project Two will be installed in the gap.

7.11.3.39 Any impacts associated with cables left in situ are expected to be mitigated by commitments included as part of Hornsea Four as described in Table 7.10.

7.11.3.40 There are not expected to be any effects on recreational vessels or smaller commercial fishing vessels given the water depths and penetration depths of their anchors which would limit the ability for them to snag an export, inter array or interconnector cable.

Magnitude of impact

7.11.3.41 Overall this impact is predicted to be of local spatial extent, long-term duration, intermittent and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **moderate**.

Sensitivity of receptor

7.11.3.42 The receptor is deemed to be generally not vulnerable, have very good recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of effect

7.11.3.43 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **moderate**. The effect will, therefore, be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Decommissioning activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources SN-D-13)

7.11.3.44 Given that the decommissioning phase will occur after three years of construction and 35 years of operational life of Hornsea Four, even with the increase in activity, there are not expected to be any perceptible effects on the emergency response capability of existing resources. On this basis, the extent of the impact is considered to be local.

7.11.3.45 Commitments included as part of Hornsea Four, which will help mitigate the impact on emergency response capability, are described in Table 7.10.

Magnitude of impact

7.11.3.46 Overall this impact is predicted to be of local spatial extent, short-term duration, intermittent and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Significance of effect

7.11.3.47 Irrespective of the sensitivity of the receptor, the significance of the impact on all vessels is **not significant** as defined in the assessment of significance matrix (Table 7.14) and is therefore not considered further in this assessment.

7.12 Cumulative Effect Assessment (CEA)

7.12.1.1 Cumulative effects can be defined as effects upon a single receptor resulting from the impacts arising from the development of Hornsea Four when considered alongside the impacts arising from other proposed and reasonably foreseeable projects and developments. This includes all projects that result in a comparative effect that is not intrinsically considered as part of the existing environment and is not limited to offshore wind farm projects.

7.12.1.2 A screening process has identified a number of reasonably foreseeable projects and developments which may act cumulatively with Hornsea Four. The full list of such projects that have been identified in relation to the offshore environment are set out in **Volume A4, Annex 5.3: Offshore Cumulative Effects** and are presented in a series of maps within **Volume A4, Annex 5.4: Location of Offshore Cumulative Schemes**.

7.12.1.3 In assessing the potential cumulative impacts for Hornsea Four in relation to shipping and navigation it is important to note that some projects, predominantly those "proposed" or identified in development plans, may not actually be taken forward, or be fully built out as described within their MDS. There is therefore a need to build in some consideration of certainty (or uncertainty) with respect to the potential impacts which may arise from such proposals. For example, those projects consented/approved are likely to contribute to cumulative impacts (providing effect or spatial pathways exist), whereas those proposals not yet approved are less likely to contribute to such an impact, as some may not achieve approval or may not ultimately be built due to other factors.

7.12.1.4 Given that the key receptors within the shipping and navigation chapter are vessels which route internationally the tiers selected consider both project status and distance from Hornsea Four. The tiers applied in the shipping and navigation CEA are summarised in **Table 7.18**, with the level of assessment undertaken for each tier included.

Table 7.18: Tiered cumulative approach.

Tier	Project Status **Project must meet one of these phases as a minimum*	Criterion	Data Confidence Level	Level of CEA
1	Under construction, consented or under determination	• May impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area and/or interacts with traffic which may be directly displaced by the Hornsea Four array area (including use of the gap between Hornsea Four and Hornsea Project Two) or HVAC booster station search area. • Raised as having possible cumulative effect during consultation undertaken for Hornsea Four. **Offshore wind farms** • Up to 50 km from the Hornsea Four array	High or medium	Quantitative cumulative re-routeing of main routes around surface piercing infrastructure

Tier	Project Status *Project must meet one of these phases as a minimum*	Criterion	Data Confidence Level	Level of CEA
		area, offshore ECC or HVAC booster station search area. **Oil, gas or carbon capture infrastructure (surface piercing)** • Up to 10 km from the Hornsea Four array area or HVAC booster station search area; or • Up to 5 km from the Hornsea Four offshore ECC.		
2	Under construction, consented or under determination	• May impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area and/or interacts with traffic which may be directly displaced by the Hornsea Four array area (including use of the gap between Hornsea Four and Hornsea Project Two) or HVAC booster station search area. **Offshore wind farms** • Between 50 and 100 km from the Hornsea Four array area, offshore ECC or HVAC booster station search area. **Oil, gas or carbon capture infrastructure (surface piercing)** • Between 10 and 20 km from the Hornsea Four array area or HVAC booster station search area; or • Between 5 and 10 km from the Hornsea Four offshore ECC.	High or medium	Qualitative cumulative re-routeing of main routes around surface piercing infrastructure
3	Pre-planning application, scoped or under examination	• Does not impact a main route passing within 1 nm of the Hornsea Four array area or HVAC booster station search area and does not interact with traffic which may be directly displaced by the Hornsea Four array area (including use of the gap between Hornsea Four and Hornsea Project Two) or HVAC booster station search area. **Offshore wind farms** • Up to 100 km from the Hornsea Four array area, offshore ECC or HVAC booster station search area. **Oil, gas or carbon capture infrastructure (surface piercing)** • Up to 20 km from the Hornsea Four array area or HVAC booster station search area;	Low	Qualitative assumptions of routeing only

Tier	Project Status *Project must meet one of these phases as a minimum*	Criterion	Data Confidence Level	Level of CEA
		or • Up to 10 km from the Hornsea Four offshore ECC.		

7.12.1.5 Offshore wind farm developments are screened out if they are over 100 km from Hornsea Four or within 100 km of Hornsea Four but not yet scoped.

7.12.1.6 Similarly, oil, gas or carbon capture infrastructure is screened out if over 20 km from the Hornsea Four array area or HVAC booster station search area or over 10 km from the Hornsea Four offshore ECC or within these parameters but not yet scoped.

7.12.1.7 The specific projects scoped into the CEA for shipping and navigation as well as the tiers into which they have been allocated are presented in Table 19.1 and Figure 19.1 in **Volume A5, Annex 7.1: Navigational Risk Assessment**. It is noted that operational projects are considered as part of the baseline and therefore are not scoped into the CEA. Note that only projects screened into the assessment for shipping and navigation based on the criteria outlined in **Table 7.18** have been assigned to tiers. For the full list of projects considered, including those screened out see **Volume A4, Annex 5.3: Offshore Cumulative Effects** and presented in a series of maps within **Volume A4, Annex 5.4: Location of Offshore Cumulative Schemes**.

7.12.2 Construction

Construction activities associated with the presence of structures within the Hornsea Four array area, offshore ECC and HVAC booster station search area as well as other offshore developments may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions

Tier 1

Main route deviations

7.12.2.1 Main route deviations have been considered in line with the MGN 654 Shipping Route Template (MCA 2021) and noting that during consultation Regular Operators indicated that:

- They would not enter the buoyed construction area; and
- They would transit through the gap between Hornsea Four and Hornsea Project Two.

7.12.2.2 Additionally, from consultation with Regular Operators and experience of existing offshore wind farms it is anticipated that commercial vessels (cargo vessels, tankers, passenger vessels etc.) will choose not to transit within an operational array and the presence of any submarine cables and pipelines will not affect routeing decisions.

7.12.2.3 It is noted that some main routes have been deviated through the gap to ensure the MDS is considered (maximum proximity to structures and minimum available sea room), whereas some vessels on such affected routes may pass around the Hornsea Four array area rather than utilise the gap. A full methodology for main route deviations is provided in Section 20.5.1 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.12.2.4 Deviations around Tier 1 CEA developments would be required for seven out of the 14 main routes identified within the Hornsea Four array area shipping and navigation study area in the existing baseline, with the level of deviation varying between a 4.2 nm decrease for Route 8 (due to the route being anticipated to utilise the navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three) and a 6.7 nm increase for Route 4.

7.12.2.5 For the displaced routes within the Hornsea Four cumulative shipping and navigation study area, the increase in distance and percentage change from the existing baseline are presented in **Table 7.19**. It is noted that increases in route length are based upon indicative final destinations and percentage changes are based upon the full route length. An illustration of the anticipated shift in the mean positions of the main commercial routes within the Hornsea Four cumulative shipping and navigation study area is presented in **Figure 7.10**.

Table 7.19: Summary of future baseline main route deviations within Hornsea Four cumulative shipping and navigation study area.

Route Number	Average Transits per Day	From Current Baseline	
		Increase in Route Length (nm)	Increase in Total Route Length (%)
4	1 to 2	6.7	2.1
6	1	5.4	1.5
8	1	-4.2	-1.3
10	0 to 1	2.9	0.8
11	0 to 1	1.0	1.0
12	0 to 1	4.6	1.3
14	0 to 1	1.1	0.7

Hornsea Four

Figure 7.10

Post wind farm cumulative main routes within cumulative study area

Hornsea Four Boundaries

- Indicative Structure Location
- Cumulative Shipping and Navigation Study Area

Hornsea Project One/Two

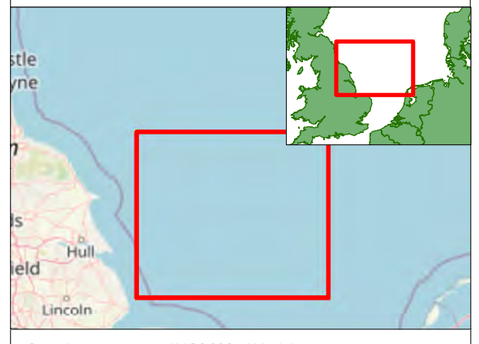
- HOW01 Infrastructure
- HOW02 Infrastructure

CEA Screened in Developments

- Offshore Wind Farm Site Boundary (Tier 1)

Main Routes (Post Wind Farm)

- Mean Position (Cumulative)



Coordinate system: WGS 1984 World Mercator

Scale@A3: 1:1,000,000

0 4.75 9.5 19 Kilometres

0 4.5 9 18 Nautical Miles

REV	REMARK	DATE
	First Issue for DCO	11/03/2020
B	Updated following project design changes, for DCO	25/11/2020
C	Updated following project design changes, for DCO	23/07/2021

Title: Hornsea Four
Document no: HOW04AN0010
Created by: DS
Checked by: JM
Approved by: SW

anatec

Ørsted

Licenses:
Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA.
© Crown copyright and database rights [2020]

Date: 14/09/2021

Author: DS

Name: 7-10 Post wind farm main routes within cumulative study area

7.12.2.6 There are no Tier 1 developments which any of the main routes within the Hornsea Four HVAC booster station search area shipping and navigation study area would be required to deviate around due to the presence of the HVAC booster stations.

Adverse weather routeing

7.12.2.7 A definition of adverse weather in the context of vessel routeing is provided in Section 16 of **Volume A5, Annex 7.1: Navigational Risk Assessment**.

7.12.2.8 The potential effect on adverse weather routeing was raised during consultation undertaken with DFDS Seaways, in relation to the Hornsea developments. Changes to DFDS Seaways commercial ferry routes in adverse weather conditions were assessed using long-term vessel traffic survey data and information provided by DFDS Seaways during consultation. The findings are summarised in **Table 7.16**.

7.12.2.9 In the cases of the Immingham to Gothenburg passing north of the Dogger Bank and North Shields to Ijmuiden adverse weather routes, the presence of Tier 1 CEA developments will have no impact upon the passage.

7.12.2.10 In the case of the Immingham to Esbjerg and Immingham to Gothenburg passing south of the Dogger Bank adverse weather routes, the only Tier 1 development which will impact upon the passage is Hornsea Three. In this case there would be an increased distance associated with deviating around Hornsea Three but this will not have any adverse impact upon navigational safety, noting that the additional deviation would be in line with the outputs of the SNSOWF study (Anatec 2013) which considered the cumulative effect of all planned offshore wind farm developments in the southern North Sea.

Increased encounters and vessel to vessel collision risk

7.12.2.11 The deviation of vessels due to the presence of construction activities associated with Hornsea Four and Tier 1 CEA developments may result in an increased number of encounters between third party vessels and consequently an increase in the vessel to vessel collision risk.

7.12.2.12 Of the five main routes for which a deviation was required for the Hornsea Four in isolation scenario, four require an identical deviation for the Tier 1 cumulative scenario, i.e. the addition of the Tier 1 CEA developments does not have any additional impact on the deviations required. For the remaining route (Route 8), the deviation required is a decrease of 4.2 nm. This is due to the need for this route to pass through the navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three, thus shortening the overall length. However, it is noted that this change is independent of the presence of Hornsea Four, i.e. this route is anticipated to utilise the navigational corridor irrespective of the presence of Hornsea Four.

7.12.2.13 Additionally, two main routes require a new deviation where one was not required for the Hornsea Four in isolation scenario, i.e. only the addition of the Tier 1 CEA developments has an impact on the route. Route 4 requires a deviation of 6.7 nm due to being deviated south of all the Hornsea developments rather than through the gap between Hornsea Four and Hornsea Project Two (as was the case in the Hornsea Four in isolation scenario). This ensures that the deviation is maximised for the MDS and aligns with the outputs of the

SNSOWF study (Anatec 2013). In reality, vessels on this route may continue to utilise the gap in the Tier 1 cumulative scenario with limited additional impact on the deviation due to the addition of the Tier 1 CEA developments (noting that at the time of the SNSOWF study the gap was not under consideration). Route 14 requires a deviation of 1.2 nm due to being deviated through the navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three.

7.12.2.14 Taking into account the similar future case vessel traffic scenario for most of the main routes and the limited vessel numbers on those routes which do require additional deviations due to the addition of the Tier 1 CEA developments, the increase in encounters and vessel to vessel collision risk with Tier 1 CEA developments is largely considered to be in line with that determined for the assessment of Hornsea Four in isolation. An increase in encounters and vessel to vessel collision risk may be expected within the navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three, although this is not considered to be a substantial increase and is a change independent of the presence of Hornsea Four, i.e. this change is anticipated irrespective of the presence of Hornsea Four.

7.12.2.15 For the Hornsea Four HVAC booster stations, given that there are no Tier 1 CEA developments which any of the main routes within the Hornsea Four HVAC booster station search area shipping and navigation study area would be required to deviate around due to the presence of the HVAC booster stations, the increase in encounters and vessel to vessel collision risk with Tier 1 CEA developments is considered to be in line with that determined for the assessment of Hornsea Four in isolation.

7.12.2.16 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) on a cumulative level with Tier 1 CEA developments is considered very high given the large sea area the Tier 1 CEA developments occupy. However, an encounter would likely last for a limited time period given that no overarching restrictions on vessel routeing will be in place other than compliance with the COLREGs (IMO 1972/77).

7.12.2.17 To date there have been no reported collision incidents involving a third party vessel within an offshore wind farm buoyed construction area. Should an encounter occur, the most likely consequences are low, i.e. collision avoidance action implemented.

7.12.2.18 As part of the Zone Appraisal and Planning (ZAP) process undertaken in 2010/11 for the Round 3 zones in the southern North Sea, key stakeholders required that an independent assessment into cumulative routeing was undertaken by the three key developers at that time. A report into shipping and navigation was undertaken by the SNSOWF in 2011 (Anatec 2011) and subsequently updated in 2013 with validated traffic plans and updated zonal plans (Anatec 2013). This included the Tier 1 offshore wind farm developments. During consultation on the SNSOWF report in 2013 no significant concerns were raised in relation to southern North Sea collision risk.

7.12.2.19 As with the equivalent impact for Hornsea Four in isolation, it is expected that vessels will be compliant with Flag State regulations including IMO conventions such as the COLREGs, SOLAS (IMO 1974) and guidance such as MGN 372 (MCA 2008). Taking this into account, along with the promulgation of information, experience at existing offshore wind farms of vessels adjusting passage plans to deviate around buoyed construction areas and sea room available there is not anticipated to be any significant increase in collision risk when considered alongside the commitments described in **Table 7.10**.

Magnitude of impact

7.12.2.20 Overall this impact is predicted to be of national spatial extent, short-term duration, continuous throughout the construction phase and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.12.2.21 The receptor is deemed to be generally not vulnerable, have good recoverability and low value, noting that the commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.12.2.22 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however acknowledging the gap between Hornsea Four and Hornsea Project Two the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

Tier 2

7.12.2.23 The only Tier 2 CEA development are the Dudgeon Extension and Sofia offshore wind farms, both of which are located a sufficient distance from the Hornsea Four array area that there is adequate sea room for vessels to adjust passage plans to avoid an increase in collision risk.

Magnitude of impact

7.12.2.24 Overall this cumulative impact is predicted to be of national spatial extent, short-term duration, continuous throughout the construction phase and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.12.2.25 The receptor is deemed to be generally not vulnerable, have very good recoverability and low value, noting that commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.12.2.26 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however given the distance to Tier 2 CEA developments and the sea room available the cumulative effect is considered to be of **neutral** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

Tier 3

7.12.2.27 The Tier 3 development identified could have the potential to create a cumulative impact with Hornsea Four construction. The Endurance Carbon Capture and Storage Lease Area has published information with regards to its proposals with construction commencing in 2023 and operation by 2026. Brine produced as part of the process will be collected from seabed wells by a flowline and then transported to platforms (either several small, unmanned installations (platforms) or fewer (one or two) larger hub unmanned installations) (National Grid 2020). These unmanned installations have the potential to create cumulative displacement and associated increased collision risk for shipping and navigation receptors; however given that the exact number and locations are unknown and the location of Hornsea Four construction buoyage is also unknown (and cannot be defined until post consent) it is not possible to make an assessment of the significance of effect. Given the small number of additional structures, the low levels of traffic anticipated to route to the north of the Hornsea Four array area, the available sea room and the commitments (**Table 7.10**) in place to manage Hornsea Four construction activities, it is not anticipated that any effects if qualified would result in a significant deviation for any receptor.

Pre-commissioned structures within the Hornsea Four array area as well as other offshore developments will create powered and drifting allision risk for all vessels

7.12.2.28 The presence of pre-commissioned structures on the perimeter of, or within, the Hornsea Four array area and other CEA developments may increase the vessel to structure allision risk for powered and drifting vessels in an emergency situation (including machinery related problems and navigational system errors). The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and CEA developments given the need to be in proximity to a wind farm structure for an allision incident to occur. However, given the greater number of wind farm structures assumed to be present, the likelihood of an allision incident is considered to be greater (albeit still remote) than when considering Hornsea Four in isolation.

Tier 1

Powered vessel to structure allision risk

7.12.2.29 When considering experience at other under construction offshore wind farms it is identified that third party vessels do consider Notification to Mariners during passage planning and avoid areas of construction, likely passing greater than 1 nm off the buoyed construction area to keep clear of any ongoing construction activity. The buoyed construction area itself at all Tier 1 CEA developments with surface piercing infrastructure will likely consist of a combination of cardinal marks and special marks which will help ensure that vessels remain a safe distance from pre commissioned wind farm structures and hence reduce the risk of a powered allision incident. The presence of operational aids to navigation post commissioning at all Tier 1 CEA developments with surface piercing infrastructure and increasing familiarity with the structures mean that the impact will have good recoverability.

7.12.2.30 The primary change from the assessment of Hornsea Four in isolation is the need for two main routes to pass through the navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three. However, it is noted that this change is independent of the presence of Hornsea Four, i.e. these routes are anticipated to utilise the navigational corridor irrespective of the presence of Hornsea Four. It should be ensured that there is no over proliferation of aids to navigation leading to confusion and full consideration should be given to the use of lighting sequences such as different light characters and varied light ranges, noting that this will be a matter actioned for Hornsea Project One, Hornsea Project Two and Hornsea Three.

7.12.2.31 Safety Zones will be applied for around active construction areas or pre-commissioned wind farm structures to ensure that those vessels (such as fishing vessels) that do choose to navigate through the array area are aware of safe passing distances. It is noted that the minimum spacing of 810 m should be sufficient for small craft to make safe passage within the array. Guard vessels will also be present where necessary to offer local advice to mariners as required. Although the minimum spacing may differ (and in some cases be lower) for some Tier 1 CEA developments, the presence of Hornsea Four should not influence vessel navigation internally within the Tier 1 CEA developments. The only possible exception to this is for the neighbouring Hornsea Project One and Hornsea Project Two; however both of these developments are considered as part of the baseline and achieve a minimum spacing of at least 810 m.

7.12.2.32 There have been no recorded incidents within UK waters associated with third party vessels experiencing a powered allision with a pre-commissioned wind farm structure and, although there have been incidents with construction vessels manoeuvring and alliding with a structure at low speed within a construction area, experience in the industry for developers, contractors and the vessel operators has and continues to increase operational procedures adopted as lessons are learnt.

7.12.2.33 Moreover, by the time of construction of Hornsea Four some of the Tier 1 CEA developments may be operational (as well as Hornsea Project Two and the Triton Knoll Offshore Wind Farm) and therefore there will be a high level of awareness of wind farm developments in the area and lessons learnt from the construction phase of these developments.

7.12.2.34 In the case of an allision incident occurring, the level of damage a vessel sustains will depend upon the energy of impact, as well as the size and structural integrity of the vessel and the sea state at the time. Being smaller and with the possibility of having a non-steel construction and the potential to navigate within the array, fishing vessels and recreational vessels are likely to be most vulnerable to the impact.

7.12.2.35 During the construction phase, Hornsea Four construction areas shall be monitored by the MHCC located in Grimsby via VHF radio and AIS but also through the presence of on-site construction vessels. This MHCC will be shared between all of the Hornsea developments, including the Tier 1 CEA development Hornsea Three, thus ensuring the most efficient possible marine coordination at a cumulative level. The presence of the MHCC, offshore VHF aerials, AIS receivers and the presence of on-site construction vessels will mean a positive impact for communication, monitoring and SAR.

7.12.2.36 Should a vessel on site require assistance, then Hornsea Four, including under SOLAS (IMO 1974) obligations, are beneficially placed to provide assets including navigational information (including weather forecasting) and safety support. Vessels associated with the other Hornsea developments may also be able to provide assistance.

Drifting vessel to structure allision risk

7.12.2.37 Incident statistics (see Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms all confirm that the frequency of machinery related failures in the area is very low and therefore the probability of a vessel being NUC in the area is also anticipated to be very low. This impact will only be present for a limited time and only when the direction of the wind or tide could cause the NUC vessel to drift within the array.

7.12.2.38 Given this low frequency and the presence of the shared MHCC and increased resources/ vessels on site at Hornsea Four, as well as at other Hornsea developments, able to render assistance (including under SOLAS obligations), the impact is considered to be effectively managed.

Allision risk associated with oil and gas infrastructure

7.12.2.39 In addition to the wind farm structures on a cumulative level creating an allision risk to vessels, the re-routeing of vessel traffic introduces an allision risk associated with other surface infrastructure, in particular oil and gas surface platforms located in proximity to Hornsea Four. It is noted that this impact considers only the effect on shipping and navigation receptors (i.e. passing vessel traffic) with the effect on the oil and gas industry considered separately in **Chapter 11: Infrastructure and Other Users**.

7.12.2.40 With the main route deviations presented in **Figure 7.10** considered, the minimum distance between a main route and a surface platform is always greater than 1 nm. Given that vessels frequently pass within 1 nm of offshore infrastructure, it can be inferred that there is sufficient sea room available for vessels to make the required deviations without being at high risk of an allision with a surface platform.

Magnitude of impact

7.12.2.41 Overall this cumulative impact is predicted to be of local spatial extent, short-term duration, continuous throughout the construction phase and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.12.2.42 The receptor is deemed to be somewhat vulnerable, have good recoverability and low value. The sensitivity of the receptor is therefore, considered to be **medium**.

Significance of the effect

7.12.2.43 Overall, it is predicted that the sensitivity of the receptor is considered to be **medium** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be slight or moderate, however given the anticipated increasing familiarity with offshore wind farms in the region and safely navigating in proximity to them, the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Tier 2

7.12.2.44 Given the local nature of the impact, Tier 2 CEA developments are not considered to have any effect since they are located a sufficient distance from Hornsea Four.

Tier 3

7.12.2.45 There is potential that the operational (by 2026) unmanned installations associated with the Endurance (Carbon Capture and Storage Lease Area) could create cumulative allision risk for shipping and navigation receptors during the construction phase of Hornsea Four. However, given that the exact number, size and locations of the unmanned installations and the location of the Hornsea Four construction buoyage is unknown it is not possible to make an assessment of the significance of effect. However given the small number of additional structures, the low levels of traffic anticipated to route to the north of the Hornsea Four array area, the available sea room for vessels to distance themselves and the Commitments (**Table 7.10**) in place to manage construction activity it is not anticipated that any effects once qualified would result in a significant deviation for any receptor.

7.12.3 Operation and Maintenance

Presence of structures associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area as well as other offshore developments may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions

7.12.3.1 It is noted that this impact considers only the risk to navigational safety due to cumulative vessel deviations rather than the risk to commercial operations, given that stakeholders clearly differentiated between the two forms of risk during consultation. The commercial impact of vessel deviations is assessed as a transboundary effect in Section 7.13.

Tier 1

Main route deviations

7.12.3.2 Main route deviations are as per the cumulative assessment of this effect for the construction phase given that, as described in the MGN 654 Shipping Route Template (MCA 2021), routes are assumed to maintain a minimum distance of 1 nm from the wind farm structures. This is a conservative assumption given that the distance at which vessels pass from the wind farm structures may be greater depending upon the sea room available and the prevailing conditions.

Adverse weather routeing

7.12.3.3 Effects on adverse weather routeing are as per the cumulative assessment of this effect for the construction phase given that the relevant deviations to routes are unchanged from the construction phase.

Increased encounters and vessel to vessel collision risk

7.12.3.4 No specific quantitative assessment of vessel to vessel collision risk has been undertaken for the cumulative scenario given that there is not a significant difference in post wind farm vessel routeing compared with the Hornsea Four in isolation scenario.

7.12.3.5 To date there have been no reported collision incidents involving a third party vessel within an operational offshore wind farm.

7.12.3.6 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) on a cumulative level with Tier 1 CEA developments during the operational phase is considered very high given the moderate volume of vessel traffic in the area compared to UK waters as a whole, the length of the operational phase, and the extent covered by the Tier 1 CEA developments. The impact is considered to be continuous given that vessels are expected to be present within the cumulative extent at all times. As with the construction phase, the consequences of most encounters are low, i.e. collision avoidance action implemented.

7.12.3.7 Given the duration of the operational phase, it is possible that some Tier 1 CEA developments may be decommissioned, therefore creating sea room not previously available and lowering the risk of a collision incident.

7.12.3.8 As part of the ZAP process undertaken in 2010/11 for the Round 3 zones in the southern North Sea, key stakeholders required that an independent assessment into cumulative routeing was undertaken by the three key developers at that time. A report into shipping and navigation was undertaken by the SNSOWF in 2011 (Anatec 2011) and subsequently updated in 2013 with validated traffic plans and updated zonal plans (Anatec 2013). This included the Tier 1 offshore wind farm developments. During consultation on the SNSOWF report in 2013 no significant concerns were raised in relation to southern North Sea collision risk.

7.12.3.9 As with the equivalent impact for Hornsea Four in isolation, it is expected that vessels will be compliant with Flag State regulations including IMO conventions such as the COLREGs (IMO 1972/77), SOLAS (IMO 1974) and guidance such as MGN 372 (MCA 2008). Taking this into account, along with the promulgation of information, experience at existing offshore wind farms of vessels adjusting passage plans to deviate around operational offshore wind farms and sea room available there is not anticipated to be any significant increase in collision risk when considered alongside the commitments described in **Table 7.10**.

Magnitude of impact

7.12.3.10 Overall this cumulative impact is predicted to be of national spatial extent, medium-term duration, continuous throughout the operational phase and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.12.3.11 The receptor is deemed to be generally not vulnerable, have good recoverability and low value, noting that the commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.12.3.12 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however acknowledging the gap between Hornsea Four and Hornsea Project Two the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

Tier 2

7.12.3.13 The only Tier 2 CEA developments are the Dudgeon Extension and Sofia offshore wind farms, both of which are located a sufficient distance from the Hornsea Four array area that there is adequate sea room for vessels to adjust passage plans to avoid an increase in collision risk.

Magnitude of impact

7.12.3.14 Overall this cumulative impact is predicted to be of national spatial extent, medium-term duration, continuous throughout the construction phase and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.12.3.15 The receptor is deemed to be generally not vulnerable have very good recoverability and low value, noting that the commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.12.3.16 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however given the distance to Tier 2 CEA developments and the sea room available the cumulative effect is considered to be of **neutral** significance, which is not significant in EIA terms (and broadly acceptable under FSA) noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

Tier 3

7.12.3.17 There is potential that the operational (by 2026) unmanned installations associated with the Endurance Carbon Capture and Storage Lease Area could create cumulative displacement and associated increased collision risk for shipping and navigation receptors. Given that the exact number and locations are unknown it is not possible to make an assessment of the significance of effect. However, given the small number of additional structures, the low levels of traffic anticipated to route to the north of the Hornsea Four array area and the available sea room it is not anticipated that any effects once qualified would result in a significant deviation for any receptor.

Operational structures within the Hornsea Four array area as well as other offshore developments will create powered and drifting allision risk for all vessels

7.12.3.18 The presence of operational structures on the perimeter of, or within, the Hornsea Four array area and other CEA developments may increase the vessel to structure allision risk for powered and drifting vessels in an emergency situation (including machinery related problems and navigational system errors). The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and CEA developments given the need to be in proximity to a wind farm structure for an allision incident to occur. However, given the greater number of wind farm structures assumed to be present, the likelihood of an allision incident is considered to be greater (albeit still remote) than when considering Hornsea Four in isolation.

Tier 1

Powered vessel to structure allision risk

7.12.3.19 Hornsea Four will potentially be the fourth offshore wind farm within the former Hornsea Zone; when considering this along with the other under construction or operational offshore wind farms within the UK REZ it is noted that vessels are familiar with navigation in proximity to WTGs.

7.12.3.20 No specific quantitative assessment of vessel to structure allision risk has been undertaken for the cumulative scenario given that there is not a significant difference in post wind farm vessel routeing compared with the Hornsea Four in isolation scenario.

7.12.3.21 The primary change from the assessment of Hornsea Four in isolation is the need for two main routes to pass through the navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three. However, it is noted that this change is independent of the presence of Hornsea Four, i.e. these routes are anticipated to utilise the navigational corridor irrespective of the presence of Hornsea Four. It should be ensured that there is no over proliferation of aids to navigation leading to confusion and full consideration should be given to the use of lighting sequences such as different light characters and varied light ranges, noting that this will be a matter actioned for Hornsea Project One, Hornsea Project Two and Hornsea Three.

7.12.3.22 It is noted that the minimum spacing of 810 m should be sufficient for small craft to make safe passage within the array. Although the minimum spacing may differ (and in some cases be lower) for Tier 1 CEA developments, the presence of Hornsea Four should not influence vessel navigation internally within the Tier 1 CEA developments. The only possible exception to this is for the neighbouring Hornsea Project One and Hornsea Project Two; however both of these developments are considered as part of the baseline and achieve a minimum spacing of at least 810 m.

7.12.3.23 To date there has only been one reported incident of a third party vessel alliding with an operational WTG. In this case a crew member on a fishing vessel left the autopilot on, resulting in an allision incident which was attended by an RNLI lifeboat.

7.12.3.24 As with the construction phase, in the case of an allision incident occurring, the level of damage a vessel sustains will depend upon the energy of impact, as well as the size and structural integrity of the vessel and the sea state at the time. Being smaller and with the possibility of having a non-steel construction and the potential to navigate within the array, fishing vessels and recreational vessels are likely to be most vulnerable to the impact.

7.12.3.25 Should a vessel on site require assistance, then Hornsea Four, including under SOLAS (IMO 1974) obligations, are beneficially placed to provide assets including navigational information (including weather forecasting) and safety support. Vessels associated with the other Hornsea developments may also be able to provide assistance.

Drifting vessel to structure allision risk

7.12.3.26 Incident statistics (see Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms all confirm that the frequency of machinery related failures in the area is very low and therefore the probability of a vessel being NUC in the area is also anticipated to be very low. This impact will only be present for a limited time and only when the direction of the wind or tide could cause the NUC vessel to drift within the array.

7.12.3.27 Given this low frequency and the presence of the shared MHCC and increased resources/vessels on site at Hornsea Four, as well as at other Hornsea developments, able to render assistance (including under SOLAS obligations), the impact is considered to be effectively managed.

Allision risk associated with oil and gas infrastructure

7.12.3.28 In addition to the wind farm structures on a cumulative level creating an allision risk to vessels, the re-routeing of vessel traffic introduces an allision risk associated with other surface infrastructure, in particular oil and gas surface platforms located in proximity to Hornsea Four. It is noted that this impact considers only the effect on shipping and navigation receptors (i.e. passing vessel traffic) with the effect on the oil and gas industry considered separately in **Chapter 11: Infrastructure and Other Users**.

7.12.3.29 With the main route deviations presented in **Figure 7.10** considered, the minimum distance between a main route and a surface platform is always greater than 1 nm. Given that vessels frequently pass within 1 nm of offshore infrastructure, it can be inferred that there is sufficient sea room available for vessels to make the required deviations without being at high risk of an allision with a surface platform.

Magnitude of impact

7.12.3.30 Overall this cumulative impact is predicted to be of local spatial extent, medium-term duration, continuous throughout the operation and maintenance phase and not reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.12.3.31 The receptor is deemed to be somewhat vulnerable, have very good recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.12.3.32 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms), however given the variable level of damage that a vessel may sustain from an allision impact, the cumulative effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA).

Tier 2

7.12.3.33 Given the local nature of the impact, Tier 2 developments are not considered to have any effect since they are located a sufficient distance from Hornsea Four.

Tier 3

7.12.3.34 There is potential that the operational (by 2026) unmanned installations associated with the Endurance Carbon Capture and Storage Lease Area could create cumulative allision risk for shipping and navigation receptors during the operation and maintenance phase of Hornsea Four. However given that the exact number, size and locations of the unmanned installations it is not possible to make an assessment of the significance of effect. However given the small number of additional structures, the low levels of traffic anticipated to route to the north of the Hornsea Four array area and the available sea room for vessels to distance themselves it is not anticipated that any effects once qualified would result in a significant deviation for any receptor.

7.12.4 Decommissioning

Decommissioning activities associated with the presence of structures within the Hornsea Four array area, offshore ECC and HVAC booster station search area as well as other offshore developments may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions

7.12.4.1 It is noted that this impact considers only the risk to navigational safety due to cumulative vessel deviations rather than the risk to commercial operations, given that stakeholders clearly differentiated between the two forms of risk during consultation. The commercial impact of vessel deviations is assessed as a transboundary effect in **Section 7.13**.

Tier 1

Main route deviations

7.12.4.2 Main route deviations are as per the cumulative assessment of this effect for the construction phase given that the buoyed decommissioning area is considered to be comparable to the buoyed construction area.

Adverse weather routeing

7.12.4.3 Effects on adverse weather routeing are as per the cumulative assessment of this effect for the construction phase given that the buoyed decommissioning area is considered to be comparable to the buoyed construction area.

Increased encounters and vessel to vessel collision risk

7.12.4.4 The deviation of vessels due to the presence of decommissioning activities associated with Hornsea Four and Tier 1 CEA developments may result in an increased number of encounters between third party vessels and consequently an increase in the vessel to vessel collision risk.

7.12.4.5 Since main route deviations are as per the cumulative assessment of this effect for the construction phase, the effect is considered to be comparable to that determined for the construction phase and subsequently also comparable to that determined for the assessment of Hornsea Four in isolation.

7.12.4.6 For the Hornsea Four HVAC booster stations, given that there are no Tier 1 CEA developments which any of the main routes within the Hornsea Four HVAC booster station search area shipping and navigation study area would be required to deviate around due to the presence of the HVAC booster stations, the increase in encounters and vessel to vessel collision risk with Tier 1 CEA developments is considered to be in line with that determined for the assessment of Hornsea Four in isolation.

7.12.4.7 The likelihood of an encounter (two vessels passing in close proximity to each other within a limited timeframe) on a cumulative level with Tier 1 CEA developments is considered very high given the large sea area the Tier 1 CEA developments occupy. However, an encounter would likely last for a limited time period given that no overarching restrictions on vessel routeing will be in place other than compliance with the COLREGs (IMO 1972/77).

7.12.4.8 To date there have been no reported collision incidents involving a third party vessel within an offshore wind farm buoyed construction area, noting the similar nature of a buoyed decommissioning area. Should an encounter occur, the most likely consequences are low, i.e. collision avoidance action implemented.

7.12.4.9 As part of the ZAP process undertaken in 2010/11 for the Round 3 zones in the southern North Sea, key stakeholders required that an independent assessment into cumulative routeing was undertaken by the three key developers at that time. A report into shipping and navigation was therefore undertaken by the SNSOWF in 2011 (Anatec 2011) and subsequently updated in 2013 with validated traffic plans and updated zonal plans (Anatec 2013). This included the Tier 1 offshore wind farm developments. During consultation on the SNSOWF report in 2013 no significant concerns were raised in relation to southern North Sea collision risk.

7.12.4.10 As with the equivalent impact for Hornsea Four in isolation, it is expected that vessels will be compliant with Flag State regulations including IMO conventions such as the COLREGs, SOLAS (IMO 1974) and guidance such as MGN 372 (MCA 2008). Taking this into account, along with the promulgation of information, experience at existing offshore wind farms of vessels adjusting passage plans to deviate around buoyed construction areas (noting the similar nature of a buoyed decommissioning area) and sea room available there is not anticipated to be any significant increase in collision risk when considered alongside the commitments described in **Table 7.10**.

Magnitude of impact

7.12.4.11 Overall this cumulative impact is predicted to be of national spatial extent, short-term duration, continuous throughout the decommissioning phase and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.12.4.12 The receptor is deemed to be generally not vulnerable, have good recoverability and low value, noting that the commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.12.4.13 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms). However, acknowledging the gap between Hornsea Four and Hornsea Project Two the effect is considered to be of **slight** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

Tier 2

7.12.4.14 The only Tier 2 CEA developments are the Dudgeon Extension and Sofia offshore wind farms, both of which are located a sufficient distance from the Hornsea Four array area that there is adequate sea room for vessels to adjust passage plans to avoid an increase in collision risk.

Magnitude of impact

7.12.4.15 Overall this cumulative impact is predicted to be of national spatial extent, short-term duration, continuous throughout the decommissioning phase and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **minor**.

Sensitivity of the receptor

7.12.4.16 The receptor is deemed to be generally not vulnerable, have very good recoverability and low value, noting that commercial value is considered in a separate impact (see **Section 7.13**). The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.12.4.17 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **minor**. According to **Table 7.14**, the effect could be either **neutral** or **slight** (which are both not significant in EIA terms). However, given the distance to Tier 2 CEA developments and the sea room available the cumulative effect is considered to be of **neutral** significance, which is not significant in EIA terms (and broadly acceptable under FSA), noting that the commercial impact of vessel deviations is considered separately as a transboundary effect in **Section 7.13**.

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Tier 3

7.12.4.18 The operational unmanned installations associated with the Endurance Carbon Capture and Storage Lease Area have the potential to create cumulative displacement and collision risk for shipping and navigation receptors. However, similar to the cumulative construction phase, information is uncertain as to the location of the unmanned installations and given the limited number of unmanned structures there are not anticipated to be any significant effects for receptors.

Decommissioning structures within the Hornsea Four array area as well as other offshore developments will create powered and drifting allision risk for all vessels

7.12.4.19 The presence of decommissioning structures on the perimeter of, or within, the Hornsea Four array area and other CEA developments may increase the vessel to structure allision risk for powered and drifting vessels in an emergency situation (including machinery related problems and navigational system errors). The extent to which the impact is present is restricted to the area local to the Hornsea Four array area and CEA developments given the need to be in proximity to a wind farm structure for an allision incident to occur. However, given the greater number of wind farm structures assumed to be present, the likelihood of an allision incident is considered to be greater (albeit still remote) than when considering Hornsea Four in isolation.

Tier 1

Powered vessel to structure allision risk

7.12.4.20 When considering experience at under construction offshore wind farms it is identified that third party vessels do consider Notifications to Mariners during passage planning and avoid areas of construction, likely passing greater than 1 nm off the buoyed construction area to keep clear of any ongoing construction activity. Buoyed decommissioning areas are expected to be treated by third party vessels similarly to buoyed construction areas. The buoyed decommissioning area itself at all Tier 1 CEA developments with surface piercing infrastructure will likely consist of a combination of cardinal marks and special marks which will help ensure that vessels remain a safe distance from decommissioning wind farm structures and hence reduce the risk of a powered allision incident. The decreasing number of wind farm structures in place as the decommissioning phase progresses and the lack of any surface structures in situ post decommissioning mean that the impact will be reversible.

7.12.4.21 The primary change from the assessment of Hornsea Four in isolation is the need for two main routes to pass through the navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three. However, it is noted that this change is independent of the presence of Hornsea Four, i.e. these routes are anticipated to utilise the navigational corridor irrespective of the presence of Hornsea Four. It should be ensured that there is no over proliferation of aids to navigation leading to confusion and full consideration should be given to the use of lighting sequences such as different light characters and varied light ranges, noting that this will be a matter actioned for Hornsea Project One, Hornsea Project Two and Hornsea Three.

7.12.4.22 Safety Zones will be applied for around active decommissioning areas to ensure that those vessels (such as fishing vessels) that do choose to navigate through the array area are aware of safe passing distances. It is noted that the minimum spacing of 810 m should be sufficient for small craft to make safe passage within the array. Guard vessels will also be present to offer local advice to mariners as required. Although the minimum spacing may differ (and in some cases be lower) for Tier 1 CEA developments, the presence of Hornsea Four should not influence vessel navigation internally within the Tier 1 CEA developments. The only possible exception to this is for the neighbouring Hornsea Project One and Hornsea Project Two; however both of these developments are considered as part of the baseline and achieve a minimum spacing of at least 810 m.

7.12.4.23 There have been no recorded incidents within UK waters associated with third party vessels experiencing a powered allision with a pre-commissioned wind farm structure and, although there have been incidents with construction vessels manoeuvring and alliding with a structure at low speed within a construction area, experience in the industry for developers, contractors and the vessel operators has and continues to increase operational procedures adopted as lessons are learnt. Given the similar nature of decommissioning works to construction, this information is considered relevant to the decommissioning phase.

7.12.4.24 Moreover, by the time of decommissioning of Hornsea Four the Tier 1 CEA developments will likely have been operational for an extended period (as well as Hornsea Project Two and Triton Knoll) (and may themselves have been decommissioned) and therefore there will be a high level of awareness of wind farm developments in the area and lessons learnt from the construction (and possibly decommissioning) phase(s) of these developments.

7.12.4.25 In the case of an allision incident occurring, the level of damage a vessel sustains will depend upon the energy of impact, as well as the size and structural integrity of the vessel and the sea state at the time. Being smaller and with the possibility of having a non-steel construction and the potential to navigate within the array, fishing vessels and recreational vessels are likely to be most vulnerable to the impact.

7.12.4.26 During the decommissioning phase, Hornsea Four decommissioning areas shall be monitored by the MHCC located in Grimsby via VHF radio and AIS but also through the presence of on-site decommissioning vessels. This MHCC will be shared between all of the Hornsea developments, thus ensuring the most efficient possible marine coordination at a cumulative level. The presence of the MHCC, offshore VHF aerials, AIS receivers and the presence of on-site decommissioning vessels will mean a positive impact for communication, monitoring and SAR.

7.12.4.27 Should a vessel on site require assistance, then Hornsea Four, including under SOLAS (IMO 1974) obligations, are beneficially placed to provide assets including navigational information (including weather forecasting) and safety support. Vessels associated with the other Hornsea developments may also be able to provide assistance.

Drifting vessel to structure allision risk

7.12.4.28 Incident statistics (see Section 13 of **Volume A5, Annex 7.1: Navigational Risk Assessment**) and lessons learnt from other offshore wind farms all confirm that the frequency of machinery related failures in the area is very low and therefore the

probability of a vessel being NUC in the area is also anticipated to be very low. This impact will only be present for a limited time and only when the direction of the wind or tide could cause the NUC vessel to drift within the array.

7.12.4.29 Given this low frequency and the presence of the shared MHCC and increased resources/vessels on site at Hornsea Four, as well as at other Hornsea developments, able to render assistance (including under SOLAS obligations), the impact is considered to be effectively managed.

Allision risk associated with oil and gas infrastructure

7.12.4.30 In addition to the wind farm structures on a cumulative level creating an allision risk to vessels, the re-routeing of vessel traffic introduces an allision risk associated with other surface infrastructure, in particular oil and gas surface platforms located in proximity to Hornsea Four. It is noted that this impact considers only the effect on shipping and navigation receptors (i.e. passing vessel traffic) with the effect on the oil and gas industry considered separately in **Chapter 11: Infrastructure and Other Users**.

7.12.4.31 With the main route deviations presented in **Figure 7.10** considered, the minimum distance between a main route and a surface platform is always greater than 1 nm. Given that vessels frequently pass within 1 nm of offshore infrastructure, it can be inferred that there is sufficient sea room available for vessels to make the required deviations without being at high risk of an allision with a surface platform.

Magnitude of impact

7.12.4.32 Overall this cumulative impact is predicted to be of local spatial extent, short-term duration, continuous throughout the decommissioning phase and reversible. It is predicted that the impact will affect the receptor directly. The magnitude is therefore, considered to be **negligible**.

Significance of the effect

7.12.4.33 Irrespective of the sensitivity of the receptor, the significance of the impact on all vessels is **not significant** as defined in the assessment of significance matrix (**Table 7.14**) and is therefore not considered further in this assessment.

Tier 2

7.12.4.34 Given the local nature of the impact, Tier 2 CEA developments are not considered to have any effect since they are located a sufficient distance from Hornsea Four.

Tier 3

7.12.4.35 The operational unmanned installations associated with the Endurance Carbon Capture and Storage Lease Area have the potential to create cumulative allision risk for shipping and navigation receptors. However, similar to the cumulative construction phase, information is uncertain as to the location of the unmanned installations and given the limited number of unmanned structures there are not anticipated to be any significant effects for receptors.

7.13 Transboundary effects

7.13.1.1 Transboundary impacts relate to impacts that may occur from an activity within one European Economic Area (EEA) state on the environment or interests of another. It was identified that transboundary issues could arise from Hornsea Four on commercial shipping routes transiting between the UK and other EEA ports.

7.13.1.2 As per **Section 7.12.3**, it is anticipated that the presence of structures associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area as well as other offshore developments may cause vessels to be deviated cumulatively. It is noted that navigational safety impacts associated with increased encounters and increased collision risk, direct consequence of the deviations, have been assessed to be of slight significance (Tier 1) or neutral significance (Tier 2) given the low significance and minor magnitude, with no effect from Tier 3 CEA developments.

7.13.1.3 Although the displacement will occur within a national spatial extent, consultation feedback from both Regular Operators and shipping representative bodies indicates that there is potential for commercial transboundary impacts given the direct consequence of deviation, increased distance and therefore increased journey time and fuel use (see **Table 7.20**). No transboundary navigational safety impacts were identified.

7.13.1.4 As per the cumulative assessment, deviations around Tier 1 CEA developments would be required for seven out of the 14 main routes identified within the Hornsea Four array area shipping and navigation study area in the existing baseline resulting in transboundary commercial impacts. The level of deviation varies between a 4.2 nm decrease for Route 8 (due to the route being anticipated to utilise the navigational corridor between Hornsea Project One, Hornsea Project Two and Hornsea Three) and a 6.7 nm increase for Route 4. No transboundary commercial impacts have been identified associated with the offshore ECC and HVAC booster station search area.

7.13.1.5 In order to assess the transboundary commercial impact an assessment of increased journey length combined with frequency of occurrence and regularity of operator has been considered. **Table 7.20** shows the routes, regularity of the operator/s and increase in journey distance. It then identifies the significance of effect on each route.

Table 7.20: Transboundary commercial impact by deviated main route.

Route number	Average transits per day	Increase in Route Length (nm)	Increase in Total Route Length (%)	Description (main ports, also may include alternative ports)	Sensitivity of Receptor – commercial transboundary impact	Magnitude to Receptor	Significance of Effect
4	1 to 2	6.7	2.1	**Immingham–Hamburg**. Route 4 is generally transited cargo vessels (50%) and tankers (35%).	**Low** Due to the receptor being generally not vulnerable.	**Minor** Due to remote occurrence (irregular operators), medium-term duration and local extent.	**Slight** (Not Significant)
6	1	5.4	1.5	**Grangemouth–Rotterdam**. Route 6 is generally transited by cargo vessels (84%).	**Low** Due to the receptor being generally not vulnerable.	**Minor** Due to remote occurrence (irregular operators), medium-term duration and local extent.	**Slight** (Not Significant)
8	1	-4.2	-1.3	**Tees–Rotterdam**. Route 8 is generally transited by cargo vessels (62%) and tankers (38%).	**Low** Due to the receptor being generally not vulnerable.	**Minor** Due to remote occurrence (irregular operators), medium-term duration and local extent.	**Slight** (Not Significant)
10	0 to 1	2.9	0.8	**Immingham–Baltic ports**. Route 10 is generally transited by cargo vessels (85%) and tankers (12%).	**Low** Due to the receptor being generally not vulnerable.	**Minor** Due to remote occurrence (irregular operators), medium-term duration and local extent.	**Slight** (Not Significant)
11	0 to 1	1.0	1.0	**Great Yarmouth–Trent gas field**. Route 11 is transited by oil and gas vessels (100%).	**Low** Due to the receptor being generally not vulnerable.	**Minor** Due to remote occurrence (irregular operators), medium-term duration and local extent.	**Slight** (Not Significant)
12	0 to 1	4.6	1.3	**Immingham–Baltic ports**. Route 12 is transited by cargo vessels (100%).	**Low** Due to the receptor being generally not vulnerable.	**Minor** Due to remote occurrence (irregular operators), medium-term duration and local extent.	**Slight** (Not Significant)
14	0 to 1	1.1	0.4	**Tees–Amsterdam**. Route 14 is generally transited by tankers (80%).	**Low** Due to the receptor being generally not vulnerable.	**Minor** Due to remote occurrence (irregular operators), medium-term duration and local extent.	**Slight** (Not Significant)

7.13.1.6 In summary, none of the deviated main routes have been identified as having a potentially significant impact placed upon them. This is because of a low sensitivity of the receptor incurred by a lack of vulnerability due to relatively small deviations (particularly when considered as a percentage increase on the total route length). It is noted that this lack of vulnerability is a result of the inclusion of the gap between Hornsea Four and Hornsea Project Two. The gap – which represents the majority of a 18% reduction in the size of the Hornsea Four array area assessed at PEIR and is excluded from the Hornsea Four Order Limits – limits the extent of some of the deviations, thus allowing operators to maintain scheduled timetables and make berthing slots/arrival times. This in turn ensures that there are no consequences on the customer base of such receptors which could have a potential impact on their business. This is particularly notable for Routes 1, 2, 3, 5 and 13 which include timetabled commercial ferries and therefore would incur a reasonably probable occurrence and moderate ranking for magnitude – however none of these routes require a deviation and so there is no effect.

7.13.1.7 It is noted that this is a substantial difference from the outcome of the high-level assessment of this transboundary effect undertaken at the PEIR stage, which identified significant issues which were reinforced by stakeholders during the Section 42 consultation process. The PEIR stated that consultation and dialogue would be undertaken in relation to potential transboundary impacts, with the main outcome of such discussions being the introduction of the gap between Hornsea Four and Hornsea Project Two in order to mitigate this transboundary issue, a mitigation which was strongly supported by the parties involved in the discussions (see 28 May 2020 and various June 2020 entries in **Table 7.4**) .

Magnitude of impact

7.13.1.8 Overall, this impact is predicted to be of international transboundary spatial extent (across all affected routes), medium-term duration, continuous throughout the operational phase and not reversible. The magnitude is therefore, considered to be **moderate**.

Sensitivity of the receptor

7.13.1.9 The receptor is deemed to be generally not vulnerable, have good recoverability and low value. The sensitivity of the receptor is therefore, considered to be **low**.

Significance of the effect

7.13.1.10 Overall, it is predicted that the sensitivity of the receptor is considered to be **low** and the magnitude is deemed to be **moderate**. As already noted, according to **Table 7.14**, the effect could be either neutral or slight (which are both not significant in EIA terms), however given that a medium-term change in vessel routeing is required from vessel operators, even if the change is not substantial in nature the transboundary effect is considered to be of **slight** significance, which is not significant in EIA terms. This impact is not considered under the FSA.

7.14 Inter-related effects

7.14.1.1 Inter-relationships are considered to be the impacts and associated effects of different aspects of the proposal on the same receptor. These are considered to be:

- Project lifetime effects: Assessment of the scope for effects that occur throughout more than one phase of the project (construction, operation and maintenance, decommissioning), to interact to potentially create a more significant effect on a receptor than if just assessed in isolation in these three key project stages (e.g. impacts on routeing and allision risk); and
- Receptor-led effects: Assessment of the scope for all effects to interact, spatially and temporally, to create inter-related effects on a receptor. As an example, all effects on shipping and navigation, such as deviated vessels, may interact to produce a different or greater effect on this receptor than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects.

7.14.1.2 Following consideration, no inter-related effects have been assessed in relation to shipping and navigation.

7.15 Conclusion and summary

7.15.1.1 For the construction phase, a total of four impacts were assessed, with the highest significance of effect determined to be slight for impacts relating to increased vessel to vessel collision risk due to deviations and resulting increased vessel to vessel encounters, powered and drifting allision risk and restricted emergency response capability. No additional commitments are considered for these impacts, and therefore the residual impacts are also slight.

7.15.1.2 For the operation and maintenance phase, a total of five impacts were assessed, with the highest significance of effect determined to be slight for impacts relating to increased vessel to vessel collision risk due to deviations and resulting increased vessel to vessel encounters, powered and drifting allision risk and restricted emergency response capability. No additional commitments are considered for these impacts, and therefore the residual impacts are also slight.

7.15.1.3 For the decommissioning phase, a total of four impacts were assessed, with the highest significance of effect determined to be slight for impacts relating to increased vessel to vessel collision risk due to deviations and resulting increased vessel to vessel encounters, powered and drifting allision risk, anchor snagging risk and restricted emergency response capability. No additional commitments are considered for these impacts, and therefore the residual impacts are also slight.

7.15.1.4 A transboundary commercial effect in relation to the displacement of vessel routeing was assessed, with the significance of effect determined to be slight. No additional commitments are considered for this impact, and therefore the residual impact is also slight.

7.15.1.5 **Table 7.21** presents a summary of the potential navigational safety impacts assessed within this ES, any Commitments and the residual effects.

Table 7.21: Summary of potential navigational safety impacts assessed for shipping and navigation[1].

Impact and Phase	Receptor and Sensitivity	Magnitude and Significance	Mitigation	Residual Impact
Construction				
Construction activities associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-C-1).	All vessels Low	Minor Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight
Pre commissioned structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (CN-C-2).	All vessels Low	Minor Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight
Pre commissioned cables associated with the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels (SN-C-3).	All vessels N/A	Negligible Not significant	None proposed beyond existing commitments in **Table 7.10**.	Not significant
Construction activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources (SN-C-4).	All vessels Medium	Minor Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight
Operation				
Presence of structures within the Hornsea Four array area, offshore ECC and HVAC booster station search area and activities associated with the Hornsea Four array area, offshore ECC and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore increased vessel to vessel collision risk for all vessels in all weather conditions (SN-O-5).	All vessels Low	Moderate Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight
Operational structures within the Hornsea Four array area and HVAC booster station search area may create powered and drifting allision risk for all vessels (SN-O-6).	All vessels Low	Minor Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight

[1] Commercial effects are covered within Section 7.13.

Impact and Phase	Receptor and Sensitivity	Magnitude and Significance	Mitigation	Residual Impact
Operational cables within the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels and cable protection used may reduce navigable water depths for all vessels (SN-O-7).	All vessels Low	Minor Neutral	None proposed beyond existing commitments in **Table 7.10**.	Neutral
Operation and maintenance activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources (SN-O-8).	All vessels Medium	Minor Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight
Operational structures within the Hornsea Four array area and offshore ECC may impact a vessel's use of its Radar, communications and navigation equipment during navigational transits (SN-O-9).	All vessels Low	Negligible Neutral	None proposed beyond existing commitments in **Table 7.10**.	Neutral
Decommissioning				
Decommissioning activities associated with the Hornsea Four array area and HVAC booster station search area may cause vessels to be deviated leading to increased encounters and therefore may also lead to increased vessel to vessel collision risk for all vessels in all weather conditions (SN-D-10).	All vessel Low	Minor Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight
Decommissioning structures within the Hornsea Four array area and HVAC booster station search area will create powered and drifting allision risk for all vessels (SN-D-11).	All vessels Low	Minor Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight
Decommissioned cables left in situ within the Hornsea Four array area and offshore ECC may increase anchor snagging risk for all vessels (SN-D-12).	All vessels Low	Moderate Slight	None proposed beyond existing commitments in **Table 7.10**.	Slight
Decommissioning activities associated with the Hornsea Four array area and offshore ECC may restrict the emergency response capability of existing resources (SN-D-13).	All vessels N/A	Negligible Not significant	None proposed beyond existing commitments in **Table 7.10**.	Not significant

7.16 References

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