Immingham Green Energy Terminal

TR030008

Volume 6

6.4 Environmental Statement Appendices

Appendix 12.A: Navigational Risk Assessment

Planning Act 2008

Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

September 2023

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

Immingham Green Energy Terminal

Development Consent Order 2023

6.4 Environmental Statement Appendices

Appendix 12.A: Navigational Risk Assessment

Regulation Reference	APFP Regulation 5(2)(a)
Planning Inspectorate Case Reference	TR030008
Application Document Reference	TR030008/APP/6.4
Author	Associated British Ports Air Products BR

Version	**Date**	**Status of Version**
Revision 1	21 September 2023	DCO Application

Immingham Green Energy Terminal Navigational Risk Assessment

Prepared by	Anatec Limited
Presented to	ABP
Date	18 August 2023
Revision Number	03
Document Reference	A4977-ABP-NRA-1

Revision Number	Date	Summary of Change
00	23 June 2023	First Issue
01	27 June 2023	Updated based on ABP comments
02	26 July 2023	Updated based on client comments
03	18 August 2023	Updated following final review

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Abbreviations Table

Abbreviation	Definition
ABP	Associated British Ports
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ALRS	Admiralty List of Radio Signals
AtoN	Aids to Navigation
CD	Chart Datum
CHA	Competent Harbour Authority
CO2	Carbon Dioxide
DfT	Department for Transport
DWT	Dead Weight Tonnage
EIAR	Environmental Impact Assessment Report
ES	Environmental Statement
EU	European Union
FSA	Formal Safety Assessment
GT	Gross Tonnage
GtGP	Guide to Good Practice
HASB	Harbour Authority Safety Board
HE	Humber Estuary
HES	Humber Estuary Services
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IERRT	Immingham Eastern Ro-Ro Terminal
IGET	Immingham Green Energy Terminal
IMO	International Maritime Organisation
IOT	Immingham Oil Terminal
kV	Kilovolt
LAT	Lowest Astronomical Tide
LLA	Local Lighthouse Authority
LPG	Liquefied Petroleum Gas

m	Metre
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
MSMS	Marine Safety Management System
nm	Nautical Mile
NPSfP	National Policy Statement for Ports
NRA	Navigational Risk Assessment
PEC	Pilot Exemption Certificate
PMSC	Port Marine Safety Code
RNLI	Royal National Lifeboat Institution
RAMS	Risk Assessment Method Statement
SHA	Statutory Harbour Authority
t	Tonnes
TOS	Traffic Organisation Service
UK	United Kingdom
UKC	Under-Keel Clearance
UKHO	UK Hydrographic Office
VTS	Vessel Traffic Service

1 Introduction

1.1 Background

This report presents the Navigational Risk Assessment (NRA) of the planned Immingham Green Energy Terminal (IGET). The NRA forms an Appendix to the Environmental Statement (ES) [TR030008/APP/6.2].

The report includes a baseline assessment of activities within the study area, i.e., the area from Humber bridge to the eastern approaches to the Humber. A detailed assessment of traffic crossing the site, a review of marine incidents within the area, findings of hazard workshop carried out with project and port personnel also form part of the NRA.

1.2 Scope of Work

The scope of work for the NRA includes the following elements:

- Project description and study area
- Data sources
- Consultation
- Baseline navigation assessment and vessel traffic analysis
- Historical marine incident review
- Hazard Identification and Risk Assessment (including Mitigation)

1.3 Guidance and Legislation

1.3.1 Primary Legislation

The Project, if consented, will be located fully within an extended Port of Immingham Statutory Harbour Authority (SHA) area where the Applicant is the SHA. The majority of the Port's marine operations are administered by the Port of Immingham Harbour Authority which forms part of ABP as the statutory port undertaker. Separately, the SHA which is governed by a range of national legislation has powers, exercised by the Harbour Master, to issue directions to ensure the efficient performance of navigation and its safety within the limits of the SHA. As a consequence, the ABP Harbour Master is statutorily empowered to issue directions to control movements of vessels within the Port of Immingham Statutory Harbour Authority (SHA) area (i.e., an extended area of water closest to the Port, encompassing the Project location) in order to ensure safety whilst the Humber Estuary Services (HES), the Competent Harbour Authority (CHA) and SHA for the wider estuary, regulates the safe navigation of that part of the Humber Estuary that lies beyond the limits of the Port of Immingham Harbour Authority area – although inevitably for purely practical and operational reasons, there is a degree of overlap between the two.

1.3.2 Policy

The National Policy Statement for Ports (NPSfP) published in 2012 provides the overarching policy against which the Project will be tested.

Paragraph 5.6.2 and 5.6.3 of the NPSfP recognises that there could be an increased risk of spills and leaks of pollutants to the water environment as a result of the infrastructure development during construction and operational activity (Ref. i). It recommends that the S) should describe and assess the impact on existing physical characteristics of the water environment affected by the proposed development and any impact of physical modification to these characteristics. Furthermore, the NPSfP recognises that the risks of impacts to the water environment can be reduced through careful design to facilitate adherence to good pollution control practice.

Sea ports and harbours provide the interface between the land, near shore and open sea. The UK Marine Policy Statement identifies, in relation to port developments and marine safety that: "Marine plan authorities and decision makers should take into account and seek to minimise any negative impacts on shipping activity, freedom of navigation and navigational safety; and ensure that their decisions are in compliance with international maritime law" (Ref. ii).

1.3.3 Secondary Guidance

The UK national standard for the safe and efficient running of ports is the Department for Transport's (DfT) 'Port Marine Safety Code' (Ref. iii) and its accompanying guidance document 'A Guide to Good Practice on Port Marine Operations' (Ref. iv) on which this NRA methodology is based.

The International Maritime Organization (IMO) Revised Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule making process (Ref. v) has also been used for supplementary guidance.

1.3.4 ALARP and Tolerability Principles

ALARP - The Port Marine Safety Code (PMSC) defines the term 'ALARP' as being 'as low as reasonably practicable' (Ref. iii). ALARP is an industry-wide standard, applying to both health and safety and port marine safety.

"Reasonably practicable" - Central to this standard is the term 'reasonably practicable'. To meet this standard, the NRA has to balance risk against the effort, time and money required to control the risk. The PMSC specifically references ALARP as an underpinning rationale for Marine Safety Management Systems (MSMS)[1] and marine risk assessments.

Risk assessment is based on a comprehensive and formal assessment of hazards and risks with a view, following assessment and mitigation of the more severe scenarios either to eliminating the hazards and risks or to reducing them to the lowest possible state, so far as is reasonably practicable.

[1] A system to manage the hazards and risks along with any preparations for emergencies – it should be developed after consultation, based on formal risk assessment and refer to an appropriate approach to incident investigation.

Where a project is proposed which may alter the navigable environment, the promoter of the scheme must consult with those likely to be involved in or affected by such alterations. The overriding aim is to ensure that any consequential risk is reduced to meet the standard of ALARP.

The Code's Guide to Good Practice (GtGP) (Ref. iv) states that the: "Judgement of risk should be an objective one, without being influenced by the financial position of the authority. The degree of risk in a particular activity or environment can, however, be balanced on the following terms against the time, trouble, cost, and physical difficulty of taking measures that avoid the risk. If these are so disproportionate to the risk that it would be unreasonable for the people concerned to incur them, they are not obliged to do so. The greater the risk, the more likely it is that it is reasonable to go to very substantial expense, trouble, and invention to reduce it. But if the consequences and the extent of a risk are small, insistence on great expense would not be considered reasonable".

This means that every hazard scenario needs to be assessed and, regardless as to whether that scenario produces a minor or significant hazard, it needs to be taken into account so as to ensure that the risks overall are ALARP. Greater emphasis is placed on significant risks to ensure that the more significant risk outcomes are mitigated with the aim of providing a safer environment.

Tolerability - Further, the concept of 'tolerability' seeks to define the point at which a risk has an unacceptable outcome (a function of frequency and consequence) when measured against key criteria. Those criteria in respect of marine safety are defined in the GtGP (Ref. iv) as:

- Human life;
- The environment;
- Tort/port user operations; and
- Port/shipping infrastructure damage.

When used as part of the assessment process, the NRA will assist an appropriate authority, such as an SHA, in determining whether or not analysed and assessed risks are tolerable or intolerable.

The GtGP (Ref. iv) states that: "Risks may be identified which are intolerable. Measures must be taken to eliminate these so far as is practicable. This generally requires whatever is technically possible in the light of current knowledge, which the person concerned had or ought to have had at the time. The cost, time and trouble involved are not to be taken into account in deciding what measures are possible to eliminate intolerable risk".

Determining whether the predicted level of risk is acceptable requires a two-part test:

- Firstly, is the risk mitigated to ALARP,
- Secondly, is the risk tolerable.

This means that where risks are identified and assessed as being tolerable, they can be accepted, and the associated activity may proceed once a position of ALARP has been reached. However, if the assessed risk remains above the tolerability line or position, then all relevant controls must be applied to it or else the given activity cannot take place.

2 Project Description

2.1 Location and Study Area

For this assessment, the study area has been designed to cover all the area over which potential direct and indirect consequences of the Project are predicted to arise during the construction and operational periods.

Figure 2.1 gives an overview of the study area. The study area has been defined as the area comprising the Humber Estuary bounded on the west by the Humber Bridge and on the east by the Humber Estuary Services (HES) SHA limit for the Humber Estuary. This study area encompasses the marine works associated with the Project, the main navigation route to and from the Project location, and considers the total utilisation of the Humber Estuary to determine the implications on vessel traffic management. The Port of Immingham SHA will be extended to include the Project location, once consented.

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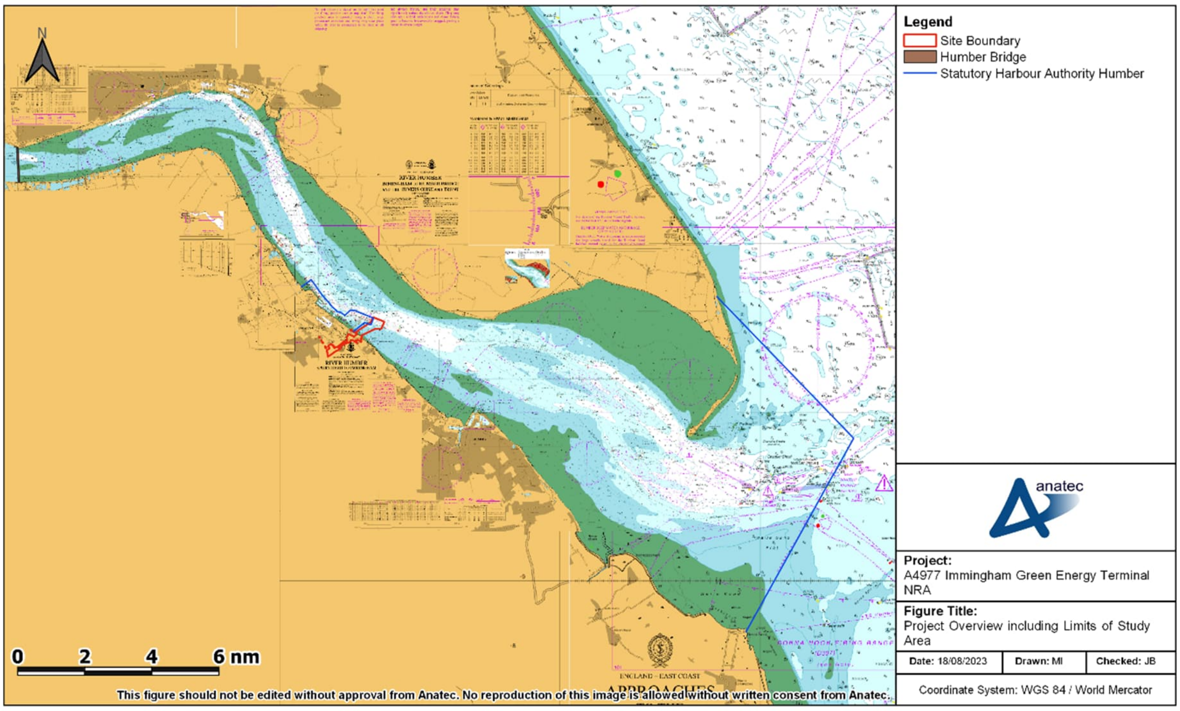

Figure 2.1 Project Overview including Limits of Study Area

Figure 2.2 gives a zoomed-in view of the site boundary and key features in the vicinity of the Port of Immingham along the south-west bank of the River Humber.

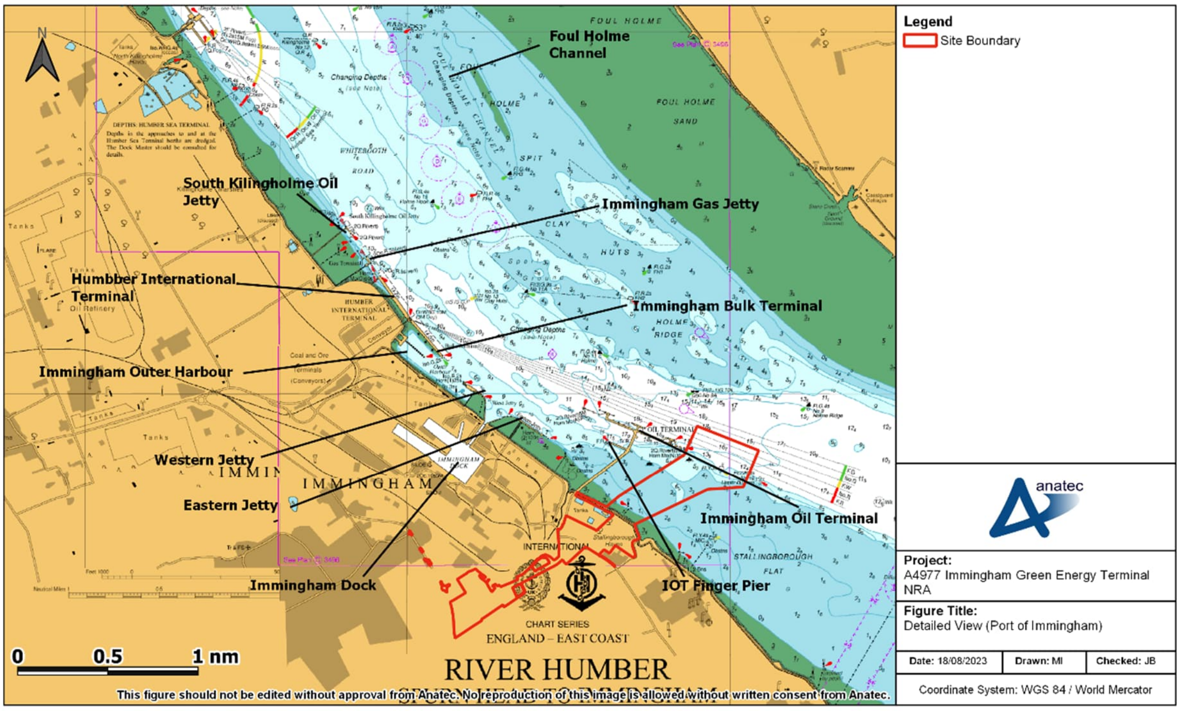

Figure 2.2 Detailed View (Port of Immingham)

The site boundary extends approximately 0.6 nautical miles (nm) from the southern side of the Humber. The Project will be aligned with the Immingham Oil Terminal (IOT) Jetty which has three tanker berths, as well as a 200 m long IOT Finger Pier (inner jetty) for product tankers. Vessels are advised against overtaking other vessels while passing IOT. The main channel narrows at this point and the wash from overtaking vessels which pass close to tankers moored at the terminal may affect their cargo handling operations. Vessels are advised to not approach nearer than 150 m from the face of the berths and pass at a speed no greater than 5 knots (Ref. vi). By aligning the Project with IOT, the channel width for passing traffic will be maintained, and similar traffic controls are planned to be implemented as in existence for IOT.

Table 2.1 summarises the normal maximum vessel dimensions for the existing parts of the Port of Immingham (Ref. vii).

Table 2.1 Normal Acceptance Dimensions of Vessels at Port of Immingham

Dock or Quay	Length (m)	Beam (m)	Draught (m)	Approx. DWT
Immingham Dock	198	26.2	10.36	38,000
Eastern & Western Jetties	213	No restriction	10.40	50,000
Immingham Oil Terminal	366	No restriction	13.10	290,000

Immingham Bulk Terminal	303	45	14.00	200,000
Immingham Gas Jetty	280	No restriction	11.00	50,000
Humber International Terminal	289	45	12.80-14.20	200,000
Immingham Outer Harbour	240	35	11	18,500

2.2 Project Design Overview

The design of the Project is shown in Figure 2.3. The berth has been aligned with IOT to the west, and includes a planned 150m exclusion zone[2] extending from the berth line. An identical zone applies at IOT based on a Standing Notice to Mariners which states that "Masters and Pilots of vessels which have to pass the IOT jetties must not approach nearer than 150m from the fact of the berths" (Ref. viii).

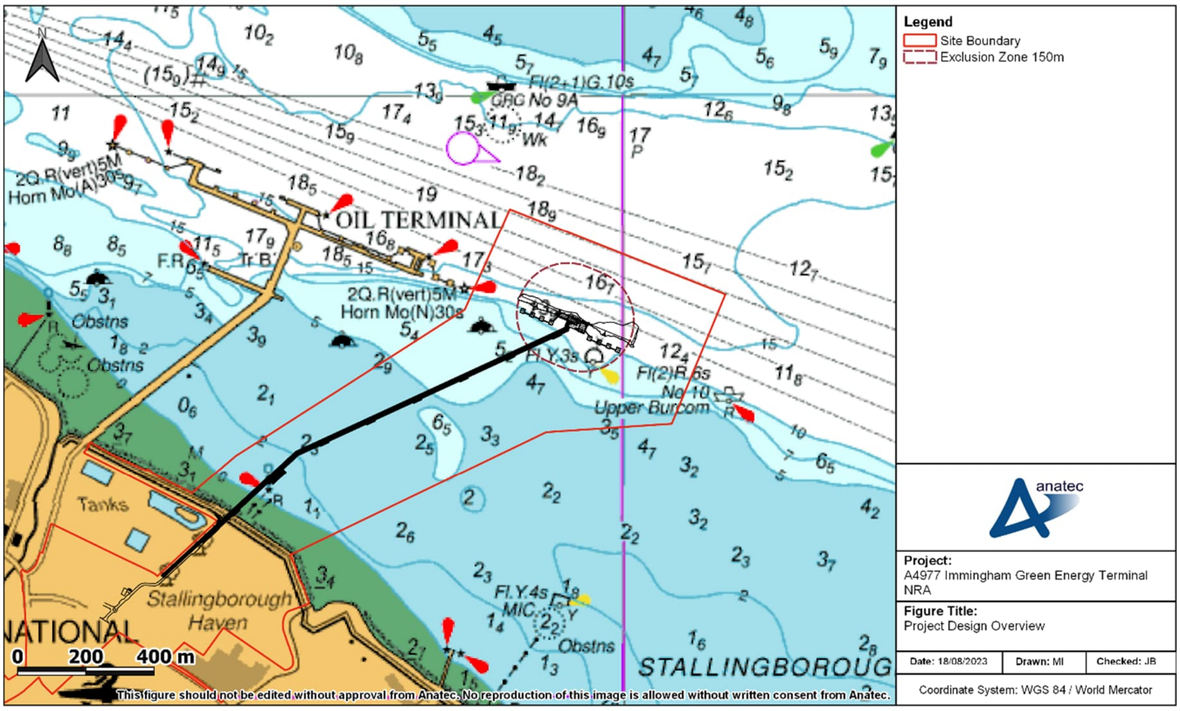

Figure 2.3 Project Design Overview

[2] The HAZID Workshop (see Appendix A) also considered an alternative option with the berth being set-back to the south to allow for a larger exclusion zone. This option is no longer being considered.

2.3 Vessel Traffic Associated with the Project

Once operational, the Project would operate 24 hours a day, 365 days a year. The maximum capacity of the Terminal would be 292 vessel calls per year, of which up to 12 would be associated with hydrogen production facility, and the remainder likely to be liquefied CO2 carriers and other bulk liquids. This number has been assessed as the worst-case scenario. The Terminal would be able to accommodate vessels of length up to 250m and draught up to 14m.

These vessels will require tugs for berthing, as well as line handling/mooring vessels as required. In addition, periodic maintenance dredging of the berthing pocket of the jetty may be required during operation.

3 Data Sources used within NRA

3.1 Introduction

This section summarises the data sources used within the NRA.

3.2 Admiralty Publications

Navigational features have been considered in this assessment and have been identified using information from UK Hydrographic Office (UKHO) Admiralty Charts 104, 3497 and 1188. These charts are used by mariners as part of the passage planning process and to plot progress during a passage and so contain all relevant navigational information.

The Admiralty Sailing Directions NP54 (12th edition 2021) issued by UKHO have also been used for reference information.

3.3 ABP Humber Publications

Information on vessel services and pilotage directions has been taken from ABP publications for Humber. These included the following documents:

- Humber Passage Plan and Berthing Procedure (Ref. ix);
- Notice to Mariners – River Humber (Ref. x); and
- Pilotage Directions for Ships to be Navigated within the Humber Pilotage Area (Ref. xi).

3.4 Automatic Identification System (AIS) Survey Data

This NRA has utilised Automatic Identification System (AIS) data for the period 1 September 2021 to 31 August 2022. This provides a data record of 365 days for the Humber Estuary.

AIS equipment (Class A) is required to be fitted on all vessels of 300 gross tonnage (GT) and upwards engaged on international voyages, cargo vessels of 500GT and upwards not engaged on international voyages, passenger vessels irrespective of size, built on or after 1 July 2002, and fishing vessels of 15m length and above. Smaller vessels (e.g., fishing vessels less than 15 m in length and recreational craft) are not required to broadcast on AIS, but may do so voluntarily typically using Class B units. The Port encourages smaller vessels to use AIS in the Humber and the proportion not doing so represent a small fraction of the overall traffic. This has been consulted upon with Port personnel and taken into account within the risk assessment. Both Class A and B vessels are included in the AIS dataset that has been used.

The AIS data have been analysed and divided into the following vessel categories:

- Port service craft (e.g., pilot vessels, port tenders etc);
- Vessels engaged in dredging or underwater operations;
- Tugs (e.g., towage tugs, fire-fighting tugs);
- Offshore support vessels (e.g., wind farm, oil and gas);

- Passenger vessels (e.g., ferries);
- Cargo vessels (e.g., general cargo vessels, ro-ro cargo vessels and bulk carriers etc);
- Tankers (e.g., oil tankers, chemical tankers, and gas carriers);
- Fishing;
- Recreational (e.g., sailing boats, yachts); and
- Unspecified/Other (e.g., military, patrol boats, lifeboats, etc).

3.5 Port Freight and Movement Statistics

Statistics for port freight and vessel movements at major ports is recorded by the DfT. This data is collected by annual returns provided by the ports and made available online (Ref. xii). It should be noted that collation of vessel movements at major ports was altered in 2017 by DfT. From 2018 onwards, the data sources used to estimate vessel arrivals changed. The primary source of data is now the Maritime and Coastguard Agency's CERS system, though data from ferry companies, ports and shipping agents collected by DfT is also still used. This means that as a result, the 2018 figures are not directly comparable with those for earlier years. In particular, for some ports the coverage of 'other vessels' (which includes non-cargo vessels) is notably different and not always available under the new methodology.

3.6 Maritime Incident Data

To characterise maritime incidents occurring within the study area, available data have been analysed from the following three sources for the ten years from 2012 to 2021 (inclusive):

- Royal National Lifeboat Institution (RNLI);
- Marine Accident Investigation Branch (MAIB); and
- ABP Humber MarNIS (Port Risk Management software) incident data.

Feedback from Humber Port indicated that the MarNIS data for 2022 was in-line with the previous data.

3.7 Consultation

3.7.1 Statutory Consultation

Statutory consultation has been carried out during Scoping and Preliminary Environmental Information Report ("PEIR") stages. This is reported in Chapter 12: Marine Transport and Navigation [TR030008/APP/6.2] and the Consultation Report [TR030008/APP/5.1].

3.7.2 Site Visit

A site visit was conducted in January 2023 to consult with Port personnel including the Harbour Master, Immingham Dock Master, and VTS.

3.7.3 Vessel Simulations

Vessel simulations were carried out at HR Wallingford's UK Ship Simulation Centre over three days between 11 and 13 April 2023, attended by port personnel and external stakeholders. This is reported within Appendix 12.B [TR030008/APP/6.4] (Ref. xiii).

3.7.4 Hazard Review Workshop

A Hazard Review Workshop was carried out on Wednesday 10 May 2023 to identify and discuss the potential hazards associated with the Project as well as their causes and control measures to mitigate the risk. Following the workshop, each identified hazard was risk assessed in terms of frequency vs. consequence based on the mostly likely (expected) outcome as well as the worst-credible outcome. The risk rankings were circulated to the group post-workshop for review and agreement.

Attendees included representatives from ABP (port owner and operators and applicant for DCO), Air Products (owner of proposed hydrogen production facility and proposed first user of the jetty), HR Wallingford (who performed the vessel simulation exercises), APT (Immingham) Ltd (terminal and port operators), CLdN (logistics solutions provider), Svitzer and SMS Towage (Towage operators for Port of Immingham), ABPmer (marine environmental specialists) and Anatec (shipping and navigation specialists).

4 Navigational Information

4.1 Introduction

The following section presents the baseline navigational information for vessel activity in the study area. The following elements are considered in the baseline:

- Statutory responsibilities and management procedures;
- Metocean conditions;
- Visual aids to navigation;
- Vessel services;
- Vessel traffic management.

4.2 Statutory Responsibilities and Management Procedures

If consented, the Project would be fully located within an extended Port of Immingham's Harbour Authority limits. ABP, in its capacity as the Harbour Authority SHA has a set of powers, duties and responsibilities which include ensuring and maintaining safe port marine operations and the regulatory control of navigational activities.

HES is the SHA for the harbour area of the Humber Estuary beyond the Port of Immingham's harbour limits, a role it fulfils as successor organisation to the Humber Conservancy Commissioner. HES is also the Competent Harbour Authority (CHA) under the Pilotage Act 1987 with respect to the Humber Estuary and the ABP Port of Immingham harbour area. In its capacity as CHA, HES has issued a set of Pilotage Directions identifying which vessels require a Pilot. HES also runs a Pilotage Exemption Certification (PEC) scheme for any ship's deck officer who demonstrates that he or she has the requisite skills, experience, and local knowledge to pilot the vessel within the compulsory pilotage area.

A Vessel Traffic Service (VTS), as described by MGN 401 (Ref. xiv), is provided for the Humber Estuary. Humber VTS maintains a vessel traffic picture through the AIS and Radar providing information on weather, vessel movements and marine safety to vessels navigating in the VTS area. All sea-going vessels are required to report to Humber VTS when entering the VTS area and at designated, charted reporting points.

ABP is also the Local Lighthouse Authority (LLA) for the Port of Immingham's SHA area by virtue of the Merchant Shipping Act 1995. As LLA, ABP is responsible for the provision and maintenance of Aids to Navigation (AtoN). ABP is required to report any defects to AtoN and consult on any proposed changes, additions, or removal of AtoN with Trinity House Lighthouse Authority (THLA) as the General Lighthouse Authority for England and Wales.

Finally, ABP in its capacity as the Statutory Harbour Authority has committed to meeting the requirements of the PMSC. The PMSC requires that ports operate an effective MSMS which is based on a set of comprehensive and regularly updated risk assessments. The MSMS for both the Port of Immingham and HES details how the harbour authorities fulfil their statutory duties and meet the marine safety requirements prescribed by the PMSC. The MSMS is subject to annual internal audits by the ABP Group's Designated Person and external PMSC audits on a three-year cyclic basis.

4.3 Metocean Conditions

A description of the existing Metocean (meteorological and oceanographic) conditions at the site are provided in the Physical Processes chapter of the ES.

4.4 Aids to Navigation (AtoN)

Aids to navigation within the study area conform to the standards of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA).

Lateral marks and a directional light are used to denote the navigable sections of the estuary, the main navigable channel, and the smaller channels. Directional lights are positioned on the Immingham Bulk Terminal and Humber Sea Terminal to assist navigation within the main channel for vessels transiting near Immingham.

Numerous additional AtoNs are present to identify the terminals and jetties at the Port of Immingham, including at the IOT to the west of the Project berth. New AtoN(s) will be installed and/or existing AtoN(s) reconfigured to ensure the Project is effectively marked and lit.

4.5 Vessel Services

Pilotage in the Humber Estuary and the Port of Immingham is provided by Humber Estuary Services. The ABP's 'Humber Pilotage Directions' (Ref. xv), defines the Humber Pilotage Area and the requirements for compulsory pilotage within it. The directions also lay down regulations under which PECs are issued and administered in the area.

Vessels subject to compulsory pilotage within the compulsory pilotage area include:

- All vessels greater than 60m length;
- All vessels over 100m moving between tidal estuary berths which includes the moving of mooring lines.

Towage is provided by a number of service providers. The vessel's size, type and draught dictate the minimum tugs that are required. Of particular note for the study area, all tankers visiting IOT up to 150,000 Deadweight Tonnage (DWT) and gas tankers over 20,000 DWT require two tugs from the Sunk Spit buoy, North of Grimsby for the passage to the berth. Tankers up to 50,000 DWT require three tugs for berthing, four tugs are required for berthing tankers between 50,000 and 150,000 DWT, and five for any vessels greater than 150,000 DWT.

Laden crude oil tankers in excess of 100,000 DWT which are visiting the IOT are required to berth with two mooring advisors, who are not pilots but who form part of the IOT team, to assist with berthing. Vessels visiting the IOT Finger Pier will be accompanied by a smaller harbour tug, owned, and operated by Briggs Marine, which is on standby at the pier.

4.6 Vessel Traffic Management

A VTS is in operation for the area designated Humber VTS (see Figure 4.1). This service provides AIS coverage throughout the VTS area and radar tracking within a large portion of the VTS area. Communications are provided over three Very High Frequency (VHF) radio channels which consist of:

- VHF channel 14 is the main operational working channel for the Humber approaches through to the meridian of longitude passing through the No.4A Clee Ness light float;
- VHF channel 12 is the main operational channel for the middle Humber up estuary of the meridian of longitude which passes through the No.4A Clee Ness light float to the Humber bridge; and
- VHF channel 15 is the main operational channel for the upper Humber inland of the Humber bridge and includes those areas of the River Ouse and River Trent.

In addition, every 2-hours the VTS service broadcasts information to mariners regarding the weather, tidal information, and navigational warnings.

4.7 Navigational Features

Figure 4.1 presents the key navigational features in the approaches to the River Humber (east of the Project).

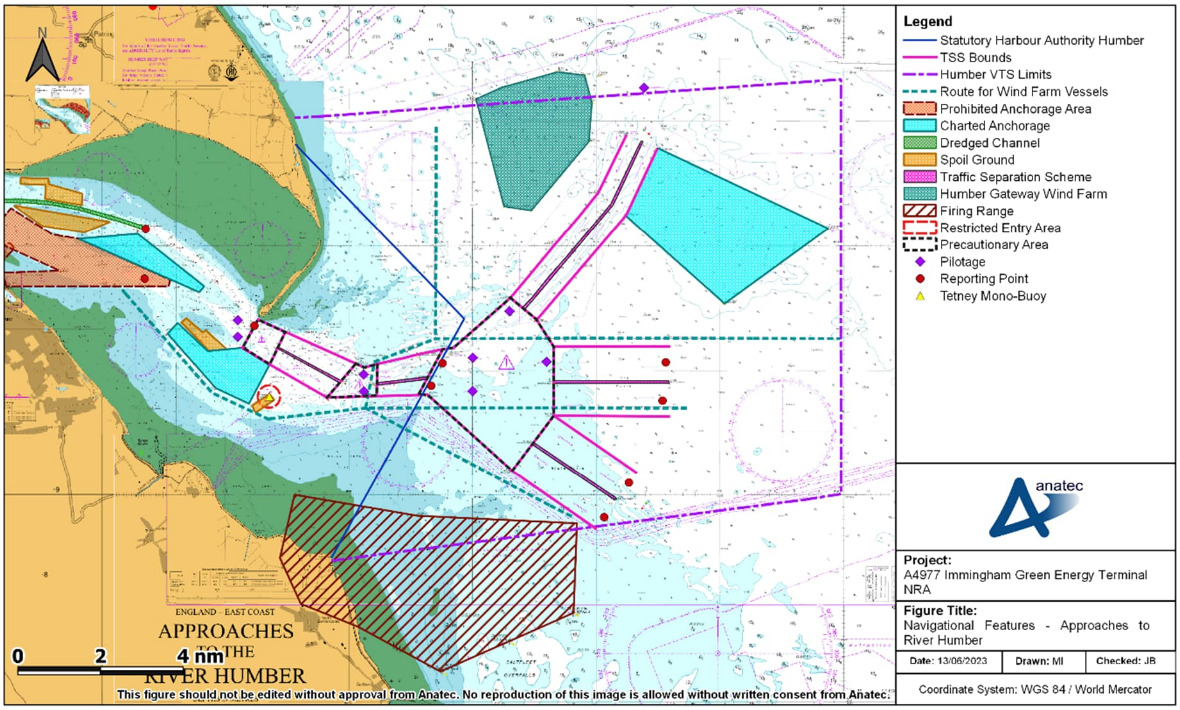

Figure 4.1 Navigational Features – Approaches to River Humber

It is noted that a Traffic Separation Scheme (TSS) exists for vessels on approach to River Humber, due to the high density of vessel traffic entering and exiting through the same area.

Deep draught vessels approaching River Humber from Dover Strait should use the TSS just north of the restricted entry area. It is noted that on occasions it will be necessary for departing deep draught vessels to navigate against the traffic flow in that part of the TSS approaching Spurn Head. From seaward three TSSs, from north-east, east and south-east, converge in an outer precautionary area. A single TSS then leads west and north-west into Humber. Two additional precautionary areas exist between TSSs leading to Humber. Numerous pilotage areas are located to help navigate the traffic using the Humber TSSs.

Humber Gateway Offshore Wind Farm is located north of the three TSSs. Recommended routes for wind farm transfer vessels have been established in the Humber approaches.

Tetney Monobuoy is a lighted mooring buoy used by large tankers for discharging oil. When the buoy is not in use a floating hose, marked by quick flashing lights, extends up to 290m from the buoy. Tankers berthing at the Monobuoy should have an Under-Keel Clearance (UKC) of 2m. Vessels are advised to keep well away from the tankers secured to the buoy or manoeuvring in its vicinity.

Donna Nook is a firing range marked by lighted buoys. Red lights or red flags are displayed when the area is in use. There are no restrictions on the right of vessels to transit the firing range at any time, although when the firing range is active it is used for intensive military activity at low level. Hence, vessels are advised against transiting through this area during a military exercise.

Figure 4.2 presents key navigational features in proximity to the site boundary.

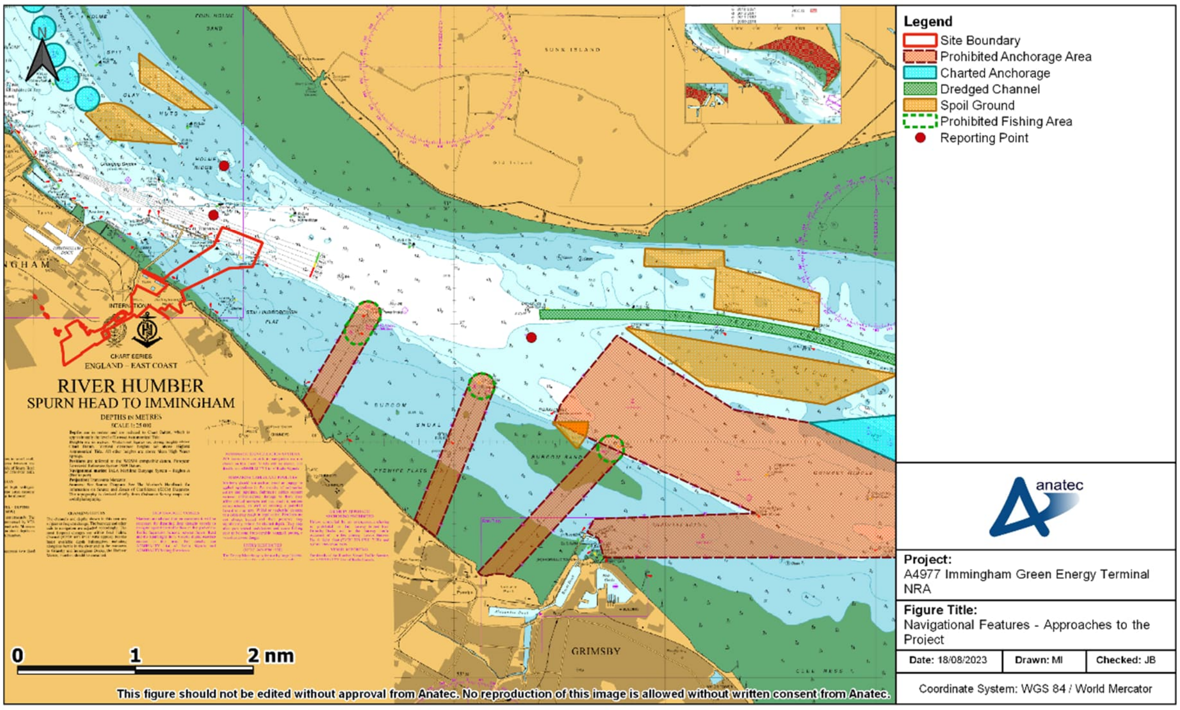

Figure 4.2 Navigational Features – Approaches to the Project

The Sunk Dredged Channel is 213m wide, located on route from Spurn Head to Immingham. It is dredged continuously. The latest available depth is announced by VTS Humber during their regular river broadcasts but is normally from 7m to 10m Lowest Astronomical Tide (LAT). Vessels intending to navigate Sunk Dredged Channel must ensure in advance that the channel is clear by calling VTS Humber prior to passing any lighted buoys (AtoN) before the channel.

The directional lights guide vessels using the main channel north of IOT, with the Project berth being aligned with IOT to ensure the available width in the channel for navigation is maintained. A secondary channel; the Foul Holme Channel, is used by vessels subject to tidal conditions, vessel draughts and UKC. It runs parallel to the main channel with a depth of at least 2.5m (at LAT). When using the Foul Holme Channel, vessels are not restricted to comply with the speed limits followed by the vessels using the main channel.

There are several prohibited anchorage and fishing areas between Grimsby and Immingham. Unless forced by an emergency, anchoring is prohibited in the fairway to and from Grimsby Docks.

There are two spoil grounds; Clay Huts disposal site (HU060) 0.8nm and Holme Channel disposal site (HU056) 1nm, north of the site boundary.

4.8 Recreational Navigation

The Humber Estuary has approximately 1,000 permanent berths and 120 visitor berths for recreational craft. The majority of recreational activity occurs during the summer months and predominantly on the weekend. There are no recreational facilities based at the Port of Immingham.

Established recreational vessel destinations in the Humber Estuary include; Hull Marina which has accommodation for 310 boats and 20 visitors, Goole Boathouse which offers 140 moorings and South Ferriby Marina which provides accommodation for 100 boats plus 20 visiting vessels. In addition, there are various creeks around the estuary providing further capacity, namely Tetney Haven (Humber Mouth Yacht Club) where small numbers of moorings are available, Stone Creek (located on the north side of the river opposite Immingham), Hessle Haven and Barrow Haven, which both provide anchorages.

5 Baseline Vessel Traffic Review

5.1 Methodology

This section presents an analysis of all vessels, based on 12 months of AIS data for the period 1st September 2021 – 31st August 2022, intersecting a gate drawn through the site boundary encompassing the proposed scheme and the 150m exclusion zone, shown in Figure 5.1. This includes an analysis of track positions, daily volumes, vessel types, and vessel sizes.

Downtime of approximately 3% over the 12 months was estimated in the AIS dataset. This has been taken into account where appropriate in the analysis, e.g., by scaling up numbers of vessels.

The chart figures focused on the part of the study area containing the Project. Due to the dense vessel traffic recorded during the 12-month period, data from a typical month (May 2022) has been displayed in chart figures for clarity, unless otherwise specified.

Tracks intersecting the gate were analysed using Anatec's *AIS Time Analyser* program. This calculated the time and direction of passage at the point at which vessels crossed the gate.

The *AIS Time Analyser* program analyses each individual track intersection, and therefore, vessels making more than one transit in a single day have been counted on each transit. For example, several tugs transited more than once per day through the gate, as did port service crafts (e.g., workboats). On the busiest day, nine crossings were made by a small vessel carrying out an inshore survey in the vicinity of the Project.

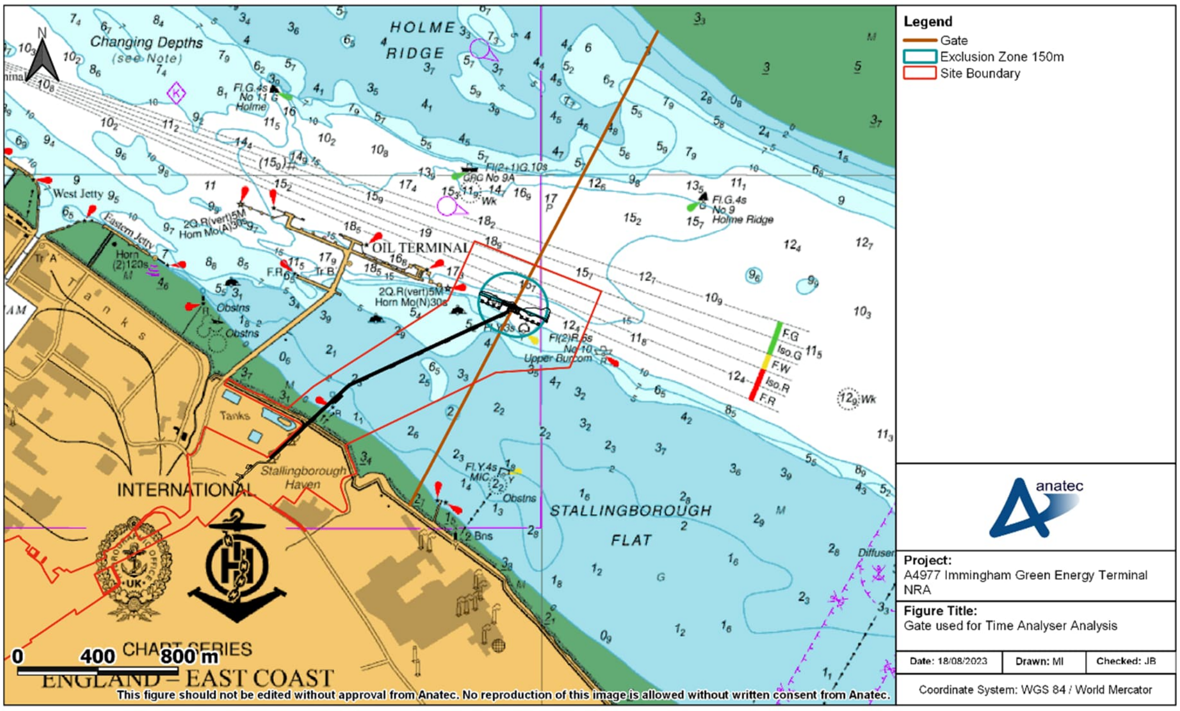

Figure 5.1 Gate used for Time Analyser Analysis

5.2 Vessel Numbers

Figure 5.2 presents the average vessel transits per month intersecting the gate during the study period.

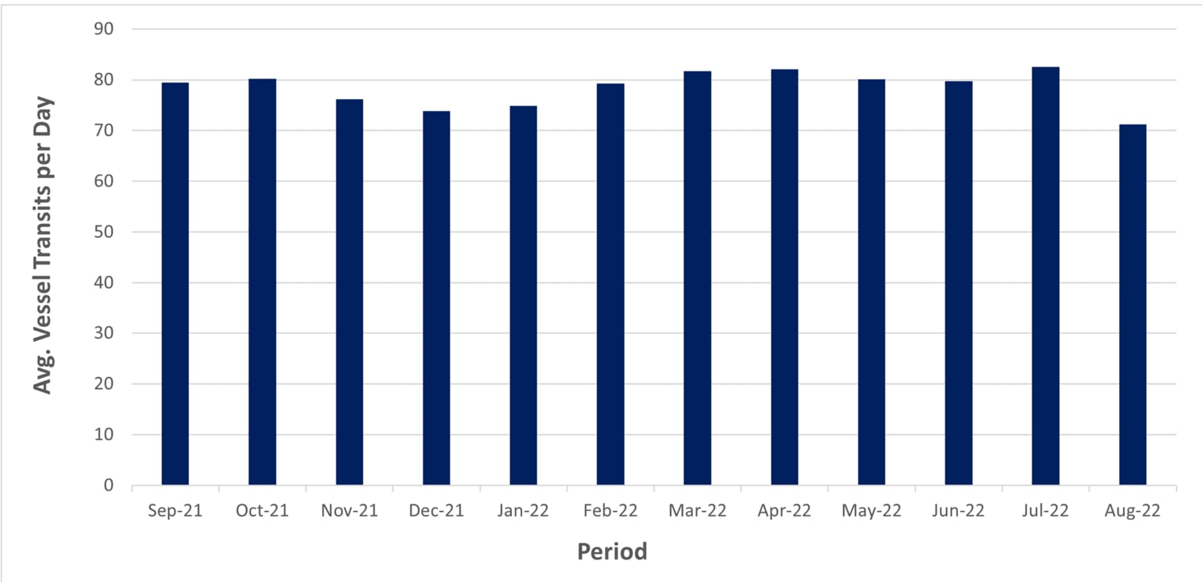

Figure 5.2 Monthly Vessel Transits (12 Months)

An average of 78 vessel transits per day crossed the gate during the 12-month study period.[3] The maximum number of transits through the gate in a day was 135 on 13th July 2022. The minimum number recorded in a day was 24 on the 25 December 2022. Overall, March, April and July 2022 were the busiest months, each with an average of 82 transits per day. August 2022 was the least busy with an average of 71 transits per day.

The density grid for the 12-month AIS dataset is presented in Figure 5.3. It represents a vessel density heat map based upon the number of AIS tracks intersecting 100 m x 100 m grid cells.

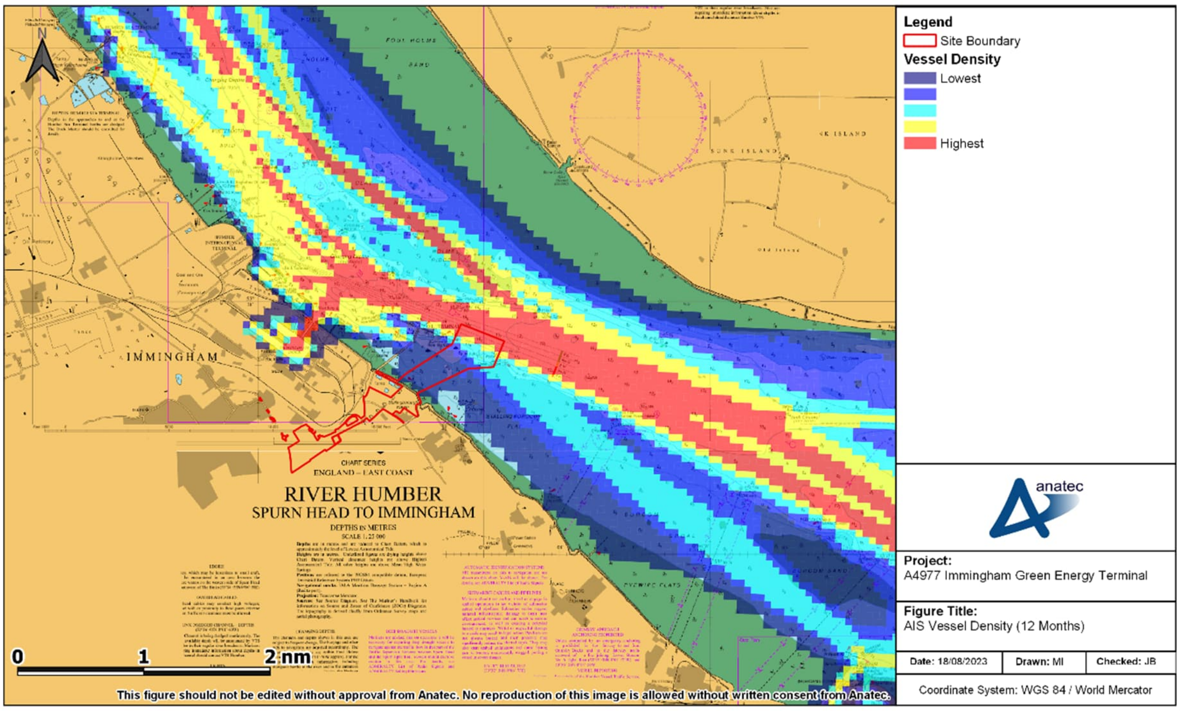

Figure 5.3 AIS Vessel Density (12 Months)

The main channel can be observed passing to the north (and overlapping the edge) of the site boundary used by vessels to / from Immingham and further upriver. The secondary channel via Foul Holme can be observed further to the north of the site boundary.

The inner (southern) part of the site boundary had limited traffic due to the shallow water depths and presence of the nearby IOT infrastructure.

5.3 Vessel Types

This section presents information on vessel types recorded within the study area.

[3] If each vessel is only counted once per day crossing the gate, the average unique vessel crossings per day is 56.

An overview of vessel traffic recorded within the area in May 2022, colour-coded by vessel type, is presented in Figure 5.4[4].

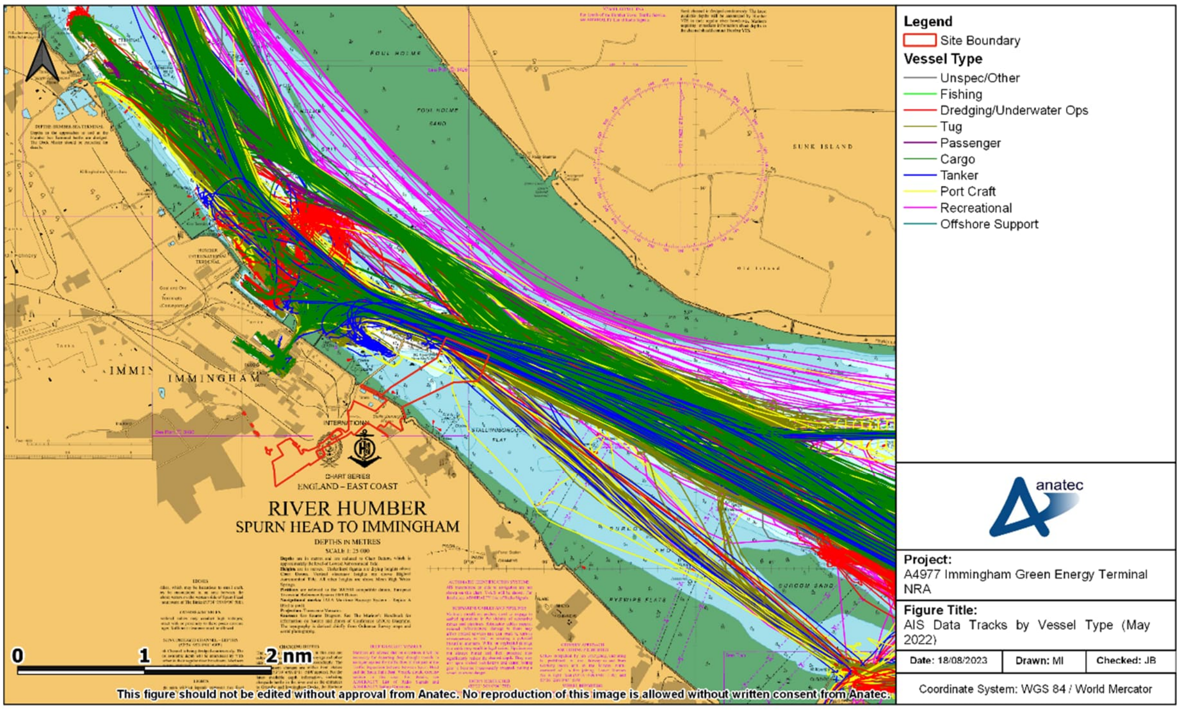

Figure 5.4 AIS Data Tracks by Vessel Type (May 2022)

It can be seen that the site boundary is in a stretch of the river which is transited by a range of vessels including port service craft (e.g., pilot boats), tankers, tugs and vessels engaged in dredging or underwater operations.

The distribution of vessels recorded crossing the gate by type during the 12-month period is presented in Figure 5.5.

[4] It is noted that small time gaps between positions being received can occasionally give the appearance of a vessel track crossing land or a jetty; this occasional slight inaccuracy does not materially affect the analysis.

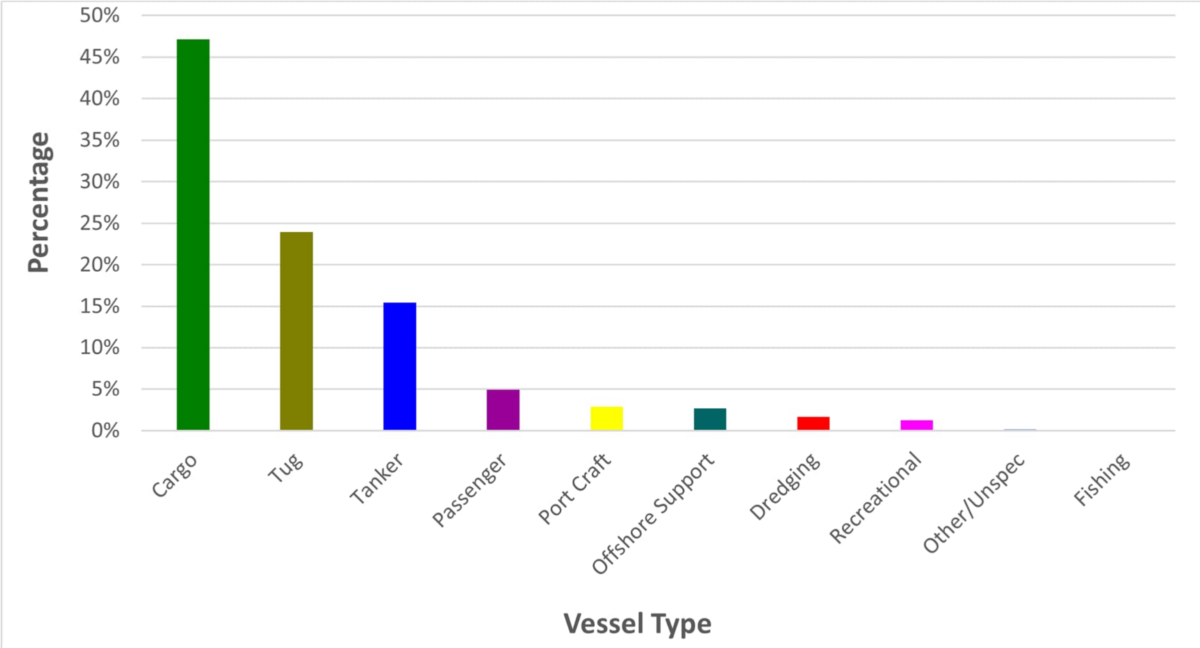

Figure 5.5 Vessel Type Distribution Crossing Gate (12 Months)

The most common vessel types recorded crossing the gate were cargo vessels (47%), followed by tugs (24%), tankers (15%) and passenger vessels (5%). Port service crafts and offshore support vessels each accounted for 3%, while recreational vessel transits accounted for 1% of the distribution. Other/unspecified and fishing vessels contributed less than 1% of the overall vessel type distribution. It is reiterated that small fishing vessels (below 15m in length) and recreational craft may be under-represented by the AIS data due to carriage requirements.

A more detailed review of vessels per type category is presented in Section 5.5.

5.4 Vessel Size

5.4.1 Vessel Length

The vessel tracks recorded in May 2022, are presented in Figure 5.6, colour-coded by vessel length.

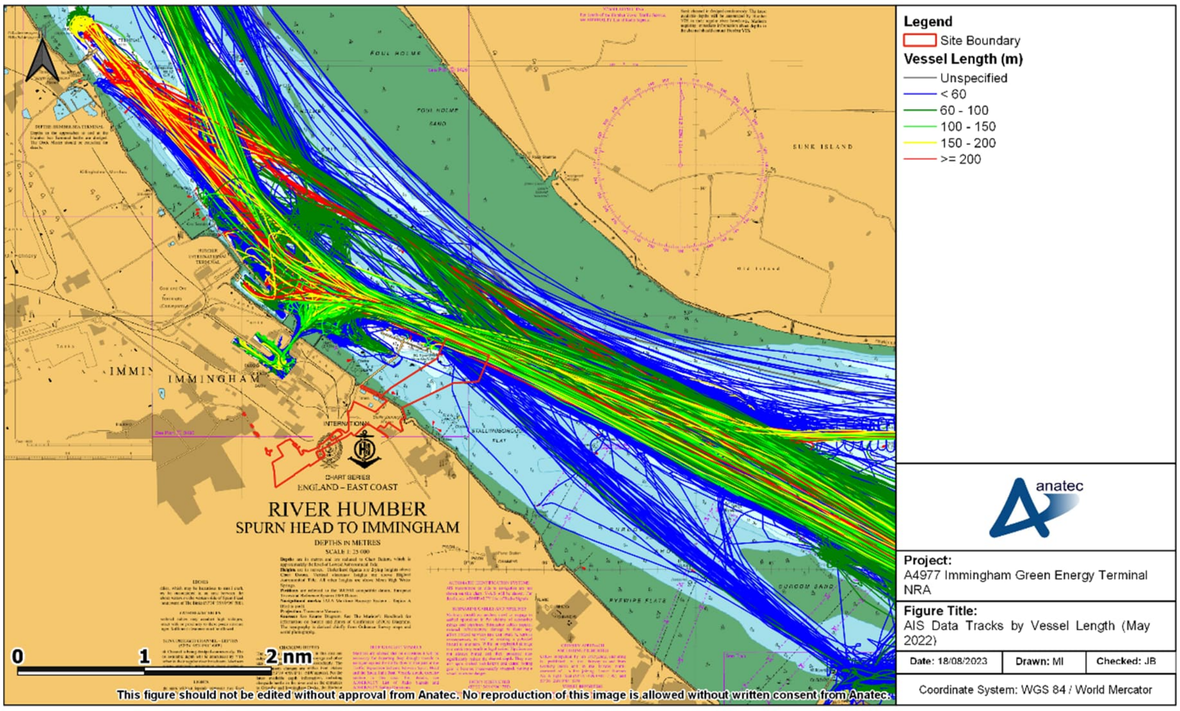

Figure 5.6 AIS Data Tracks by Vessel Length (May 2022)

The majority of vessel transits recorded crossing the gate were less than 120m in length. The vessels recorded crossing the site boundary were mostly tugs of smaller lengths (less than 60 m). It can be noted that larger vessels of lengths greater than 200m were not recorded within Immingham Dock due to their size.

The vessel length distribution based on the gate analysis, excluding unspecified lengths (less than 1%) recorded during the 12-month study period is summarised in Figure 5.7.

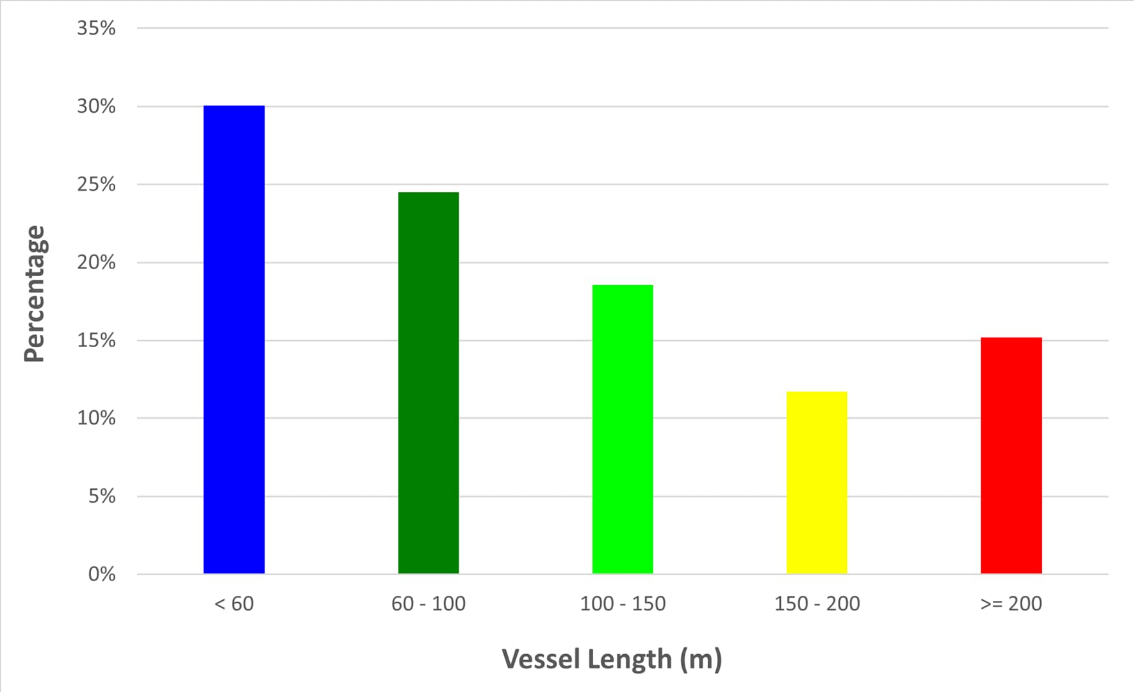

Figure 5.7 Vessel Length Distribution (12 Months)

The average vessel length recorded crossing the gate was 106m. The longest vessel recorded was a 300m bulk carrier transporting cargo to/from the Immingham Bulk Terminal.

5.4.2 Vessel Draught

Figure 5.8 presents vessel tracks recorded in May 2022, colour-coded by vessel draught. Following this, Figure 5.9 summarises the vessel draught distribution based on the gate analysis, excluding unspecified draughts (8%) recorded during the 12-month period.

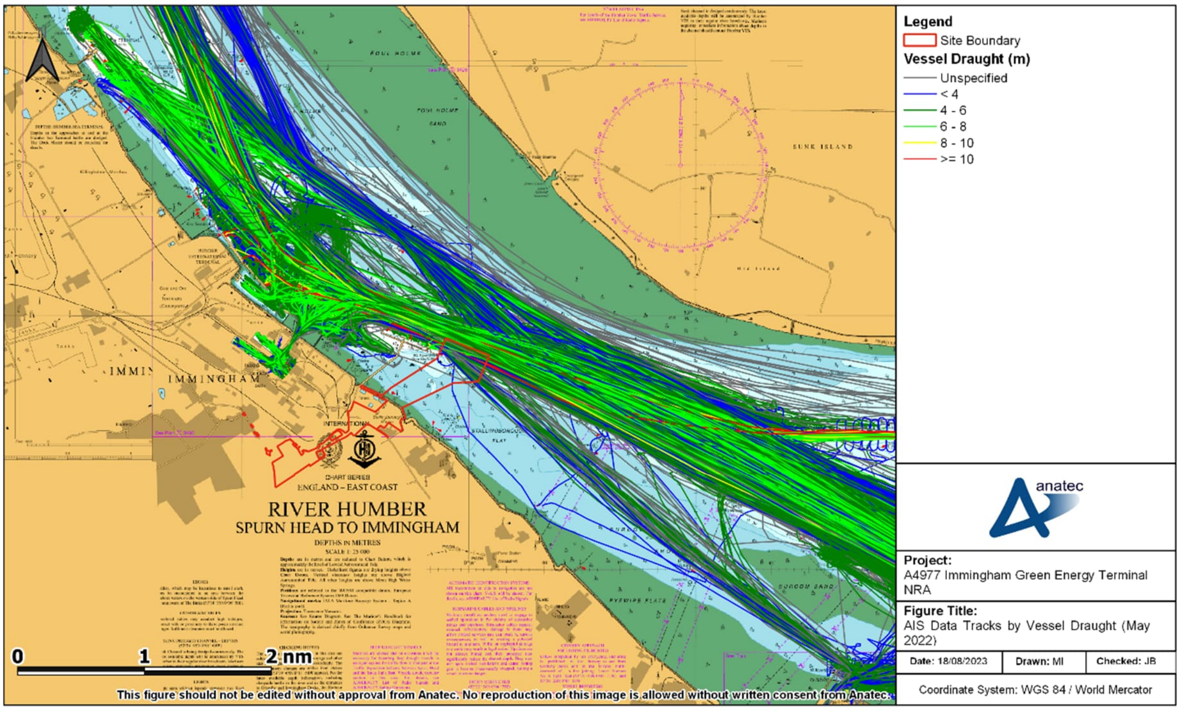

Figure 5.8 AIS Data Tracks by Vessel Draught (May 2022)

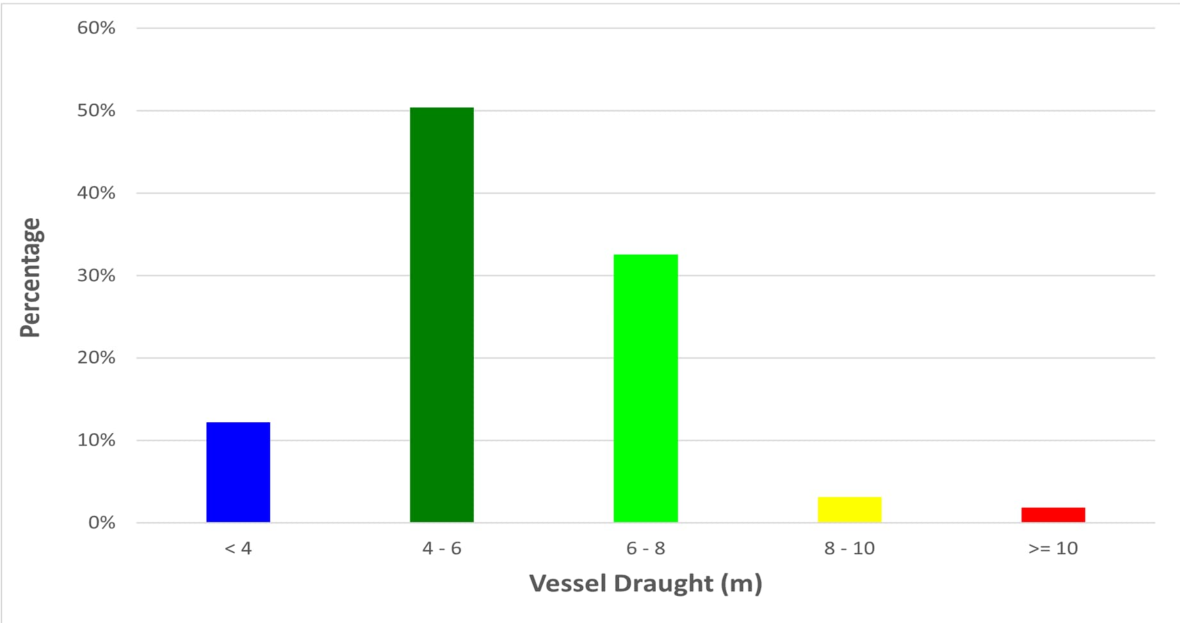

Figure 5.9 Vessel Draught Distribution (12 Months)

The average draught recorded was 5.6m. The deepest draught recorded was 13.9m by two crude oil tankers transiting (inbound) to IOT and a bulk carrier transiting (inbound) to the Immingham Bulk Terminal.

5.5 Detailed Review per Type Category

This section presents a summary of all vessel tracks, based on vessel types that accounted for more than 1% in the type distribution (Figure 5.5).

5.5.1 Port Service Crafts

Figure 5.10 gives an overview of all port craft tracks recorded during the 12 month period. These mostly consist of pilot vessels, port tenders, and workboats.

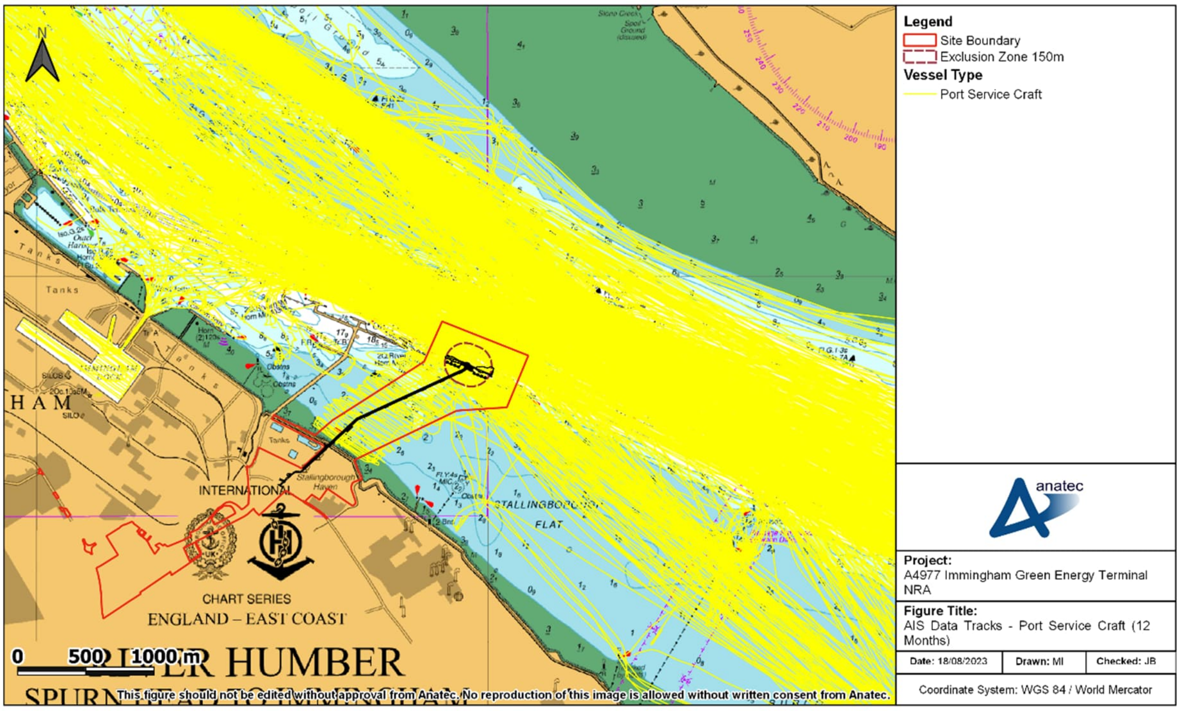

Figure 5.10 AIS Data Tracks - Port Service Craft (12 Months)

Overall, research/survey vessels were recorded transiting the site boundary, Immingham Dock and Humber International Terminal (HIT). Pilot vessels were mostly observed transiting north of site boundary.

It is noted that vessel movements associated with port service craft are not of particular concern due to their size and manoeuvrability.

5.5.2 Tankers

Tankers account for a significant number of vessel movements within the area. These vessels regularly operate throughout the Spurn Head to Immingham section of the Humber, with further traffic heading upriver. Tankers regularly utilise the South Killingholme Oil Jetty, Immingham Gas Terminal, Immingham Outer Harbour Berths, the Western and Eastern Jetty and the IOT. Larger tankers use the IOT's three outer berths, while smaller coastal product tankers and bunker barges use the four berths of IOT's Finger Pier.

Figure 5.11 gives an overview of all tanker tracks recorded during the 12-month period, colour-coded by tanker types.

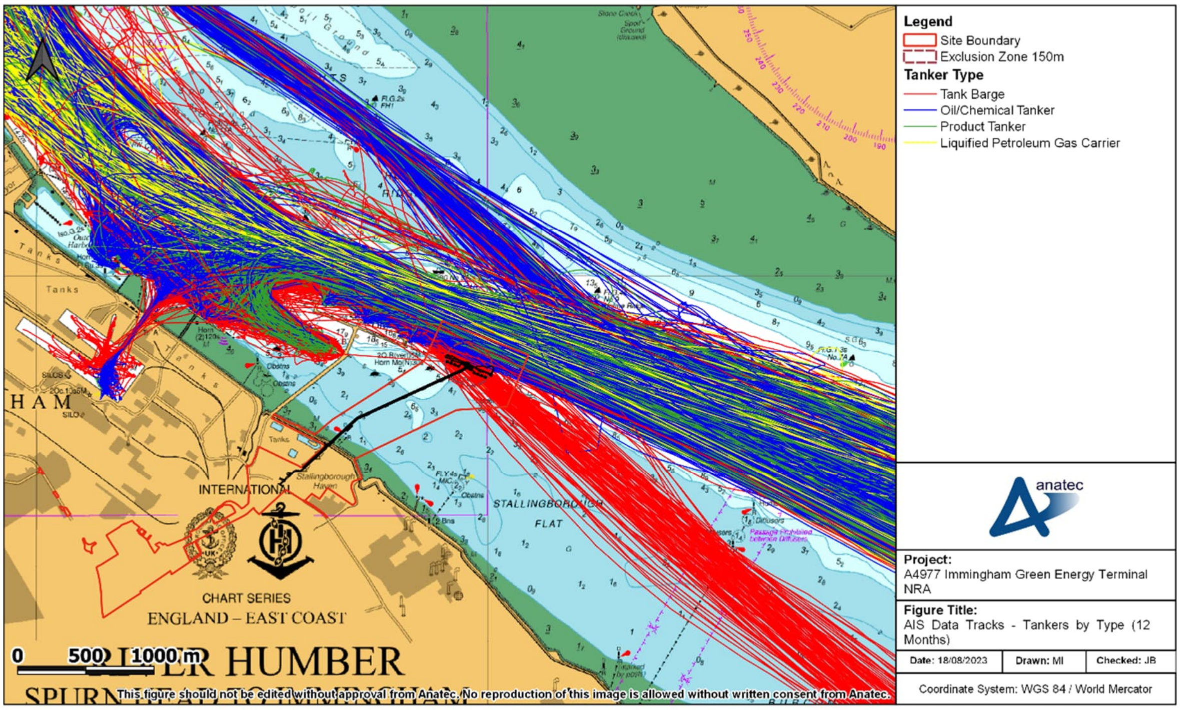

Figure 5.11 AIS Data Tracks - Tankers by Type (12 Months)

It can be noted that the majority of product tankers were recorded using the IOT Finger Berth. Liquified Petroleum Gas (LPG) carriers were recorded transiting to/from the South Killingholme Oil Jetty and Immingham Gas Terminal, approximately 2nm northwest of the site boundary.

Tank barges and oil/chemical tankers were mostly observed transiting to/from the IOT Finger Pier and Immingham Dock. These barges load cargoes at the Finger Pier before transiting to various locations around the river in order to refuel ships. Tank barges are categorized as tankers within AIS datasets, and their movements account for the majority of tanker traffic in areas not generally frequented by tankers, such as Immingham Dock.

5.5.3 Tugs

Tugs are mainly used to assist large vessels, in particular, cargo vessels and tankers for manoeuvring in the area. The number of tugs required by vessels needing to manoeuvre in the area around the site boundary, depends on the vessel's size, type and draught.

Based on the general towage information in the Humber Passage Plan (Ref. ix), tugs are classed as follows:

- Class A – 50 metric tonnes (t) or over bollard pull;
- Class B – 40t or over bollard pull and less than 50t;

- Class C – 30t or over bollard pull and less than 40t.

Towage tugs used by the Port of Immingham are provided by two operators; Svitzer Humber Ltd and SMS Towage Ltd. Their lengths range between 24m to 32m, with draughts between 3.5m and 5.9m. Smaller harbour tugs, owned and operated by Briggs Marine are used for accompanying vessels using the Finger Pier at IOT e.g., tank barges and product tankers.

Figure 5.12 gives an overview of tug tracks recorded during the 12-month period, colour-coded by vessel length.

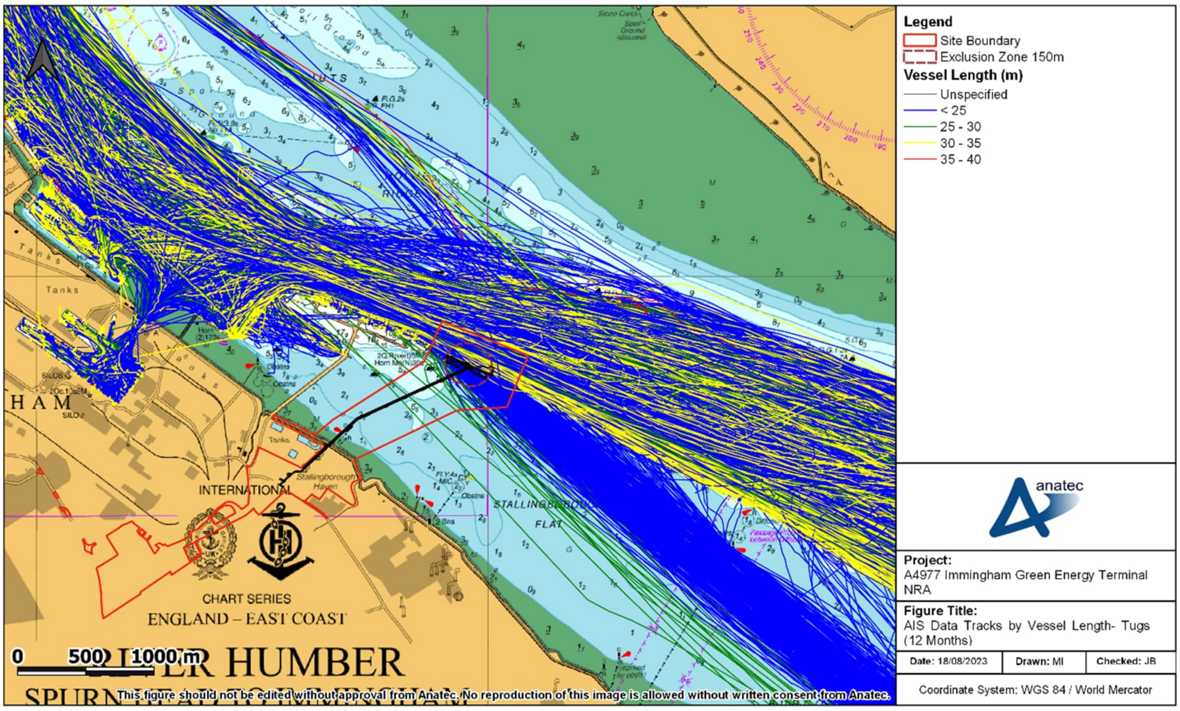

Figure 5.12 AIS Data Tracks by Vessel Length- Tugs (12 Months)

It can be noted that more than half of the vessel tracks were less than 30m in length. Tugs of longer lengths (more than 35m) accounted for less than 1% of the overall distribution.

Figure 5.13 shows a large tanker track with a DWT of 22,423, transiting westbound. It is being assisted by two tugs, one on either side during 0300-0500 hrs, on the 13 July 2022.

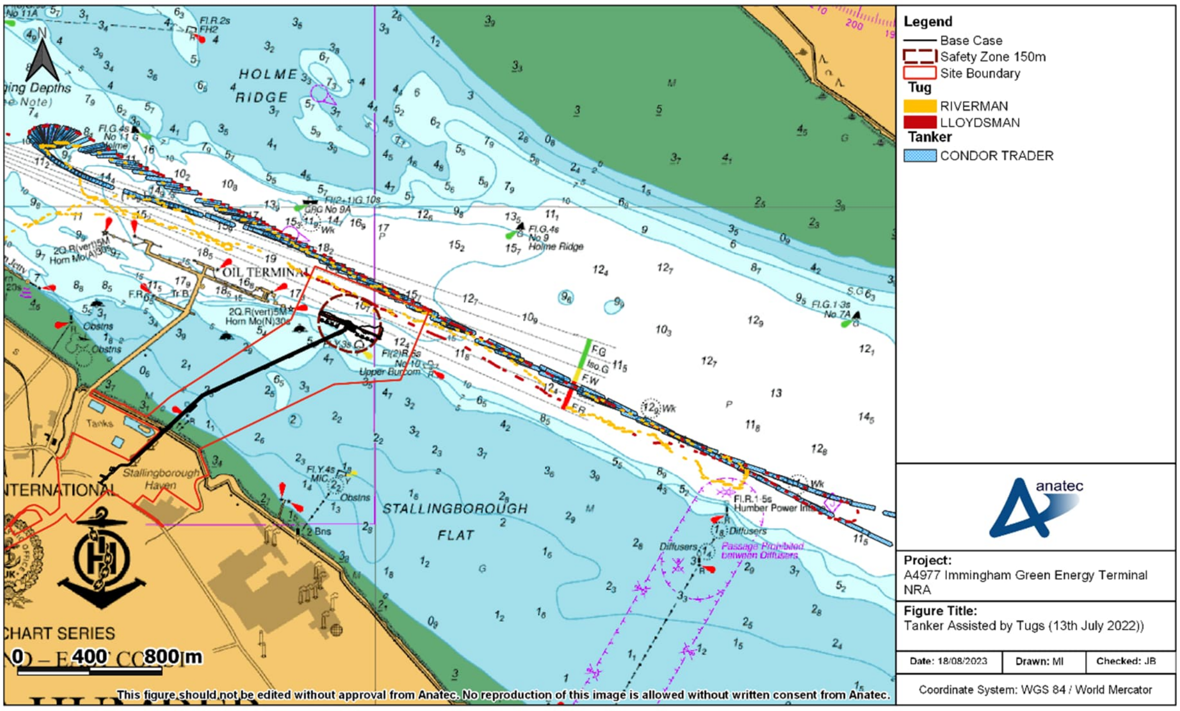

Figure 5.13 Tanker Assisted by Tugs (13th July 2022)

The tanker was recorded passing at a distance of approximately 260m north of IOT, and completed its manoeuvre after crossing the busy traffic area in vicinity of IOT berths.

5.5.4 Cargo Vessels

Figure 5.14 give an overview of cargo vessel tracks recorded during the 12-month period, colour-coded by type.

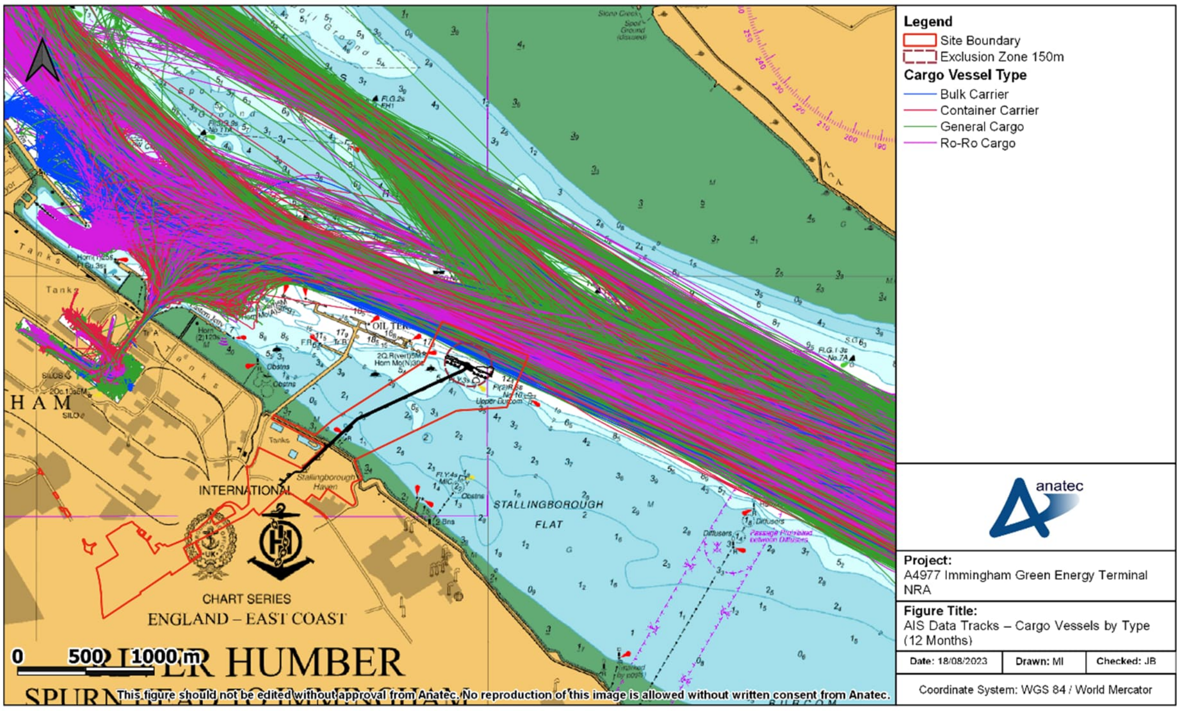

Figure 5.14 AIS Data Tracks – Cargo Vessels by Type (12 Months)

Vessels carrying general cargo were observed using the Foul Holme Channel as well as the main channel. Bulk carriers were recorded transiting to/from the Immingham Bulk Terminal. The majority of ro-ro cargo carriers were recorded transiting to/from the Immingham Outer Harbour and Humber Sea Terminal, with some using the Foul Holme Channel to transit to Hull.

5.5.5 Passenger Vessels

Figure 5.15 give an overview of passenger vessel tracks recorded during the 12-month period.

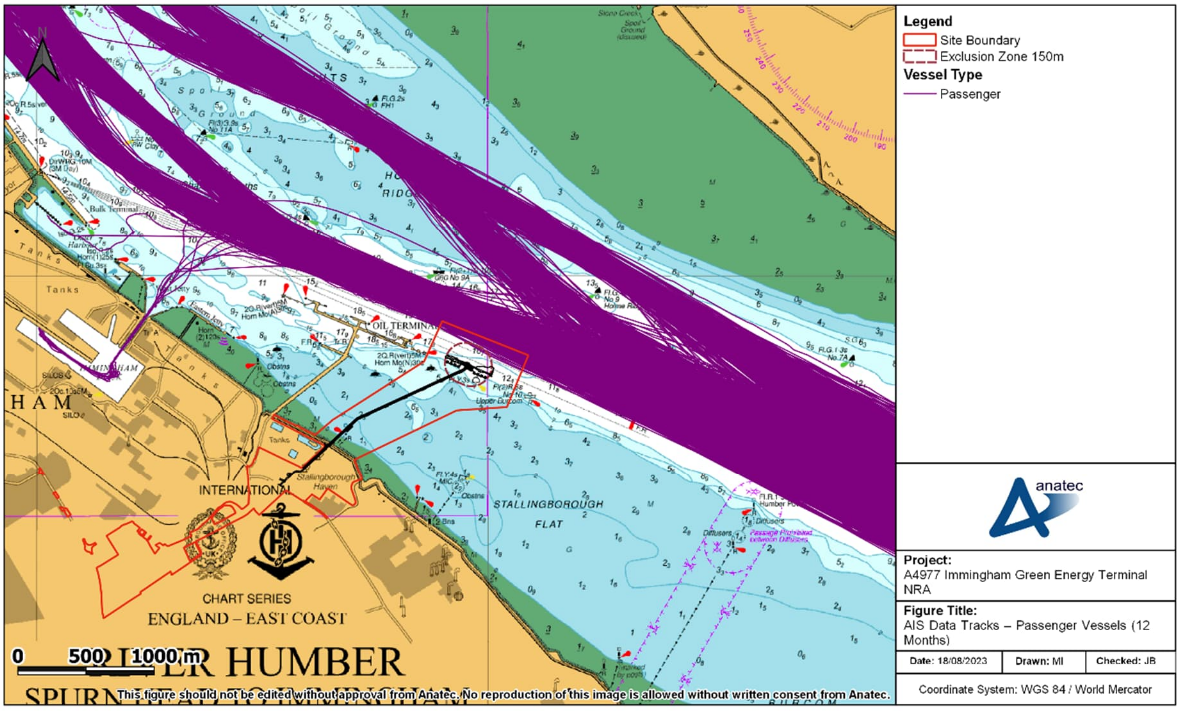

Figure 5.15 AIS Data Tracks – Passenger Vessels (12 Months)

Passenger vessels comprised of ferries operated by P&O North Sea Ferries (Hull to Rotterdam) and Stena Lines (Killingholme to Netherlands). Vessels passed north of the Project and IOT when making their way to/from the Humber Sea Terminal, North Killingholme.

5.5.6 Dredging/Underwater Operations

Figure 5.16 gives an overview of vessel tracks involved in dredging/underwater operations recorded during the 12-month period, colour-coded by vessel length.

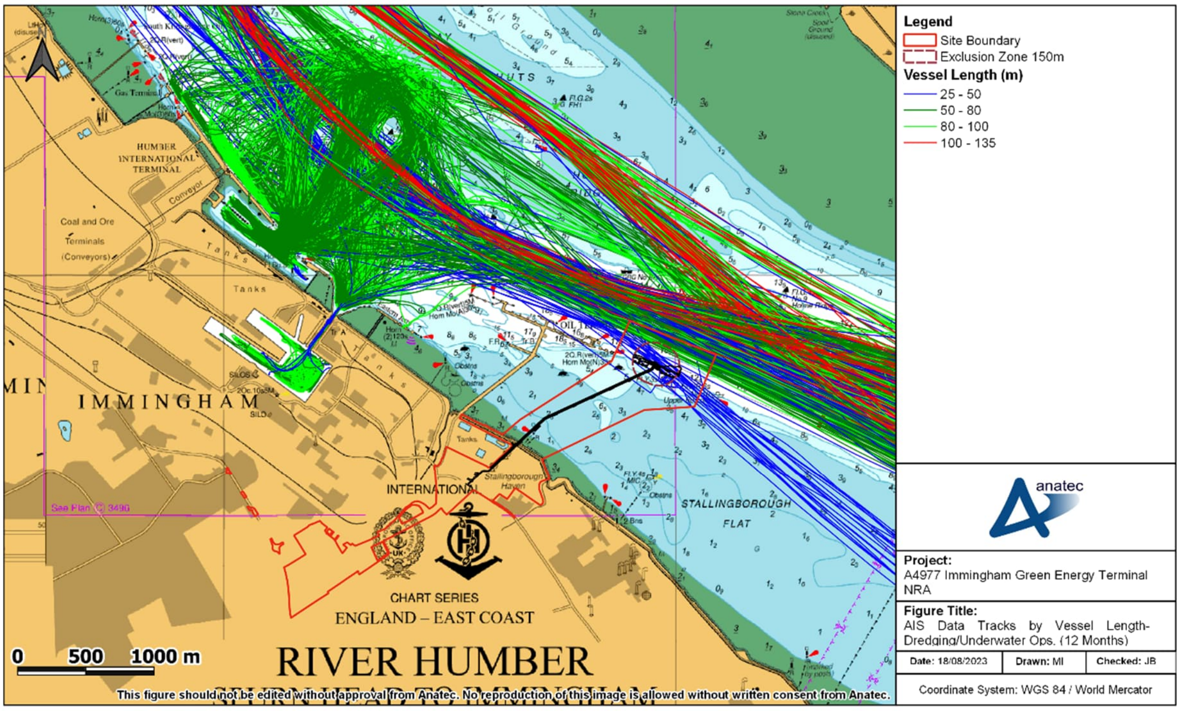

Figure 5.16 AIS Data Tracks by Vessel Length- Dredging/Underwater Ops. (12 Months)

During the 12-month study period, dredging activity was most prominent in River Humber adjacent to the West Jetty and HIT, with vessel lengths ranging from 50m to 100m.

Smaller dredging vessels of lengths between 25m to 50m were mostly observed either transiting through the area, or moored within Immingham Dock and West Jetty. It was noted that vessel tracks of lengths greater than 100m were recorded only transiting through the area, rather than involved in any dredging/underwater operations.

5.5.7 Offshore Support Vessels

Figure 5.17 give an overview of offshore support vessel tracks recorded during the 12-month period. These mostly consist of crew transfer vessels to Humber Gateway Wind Farm.

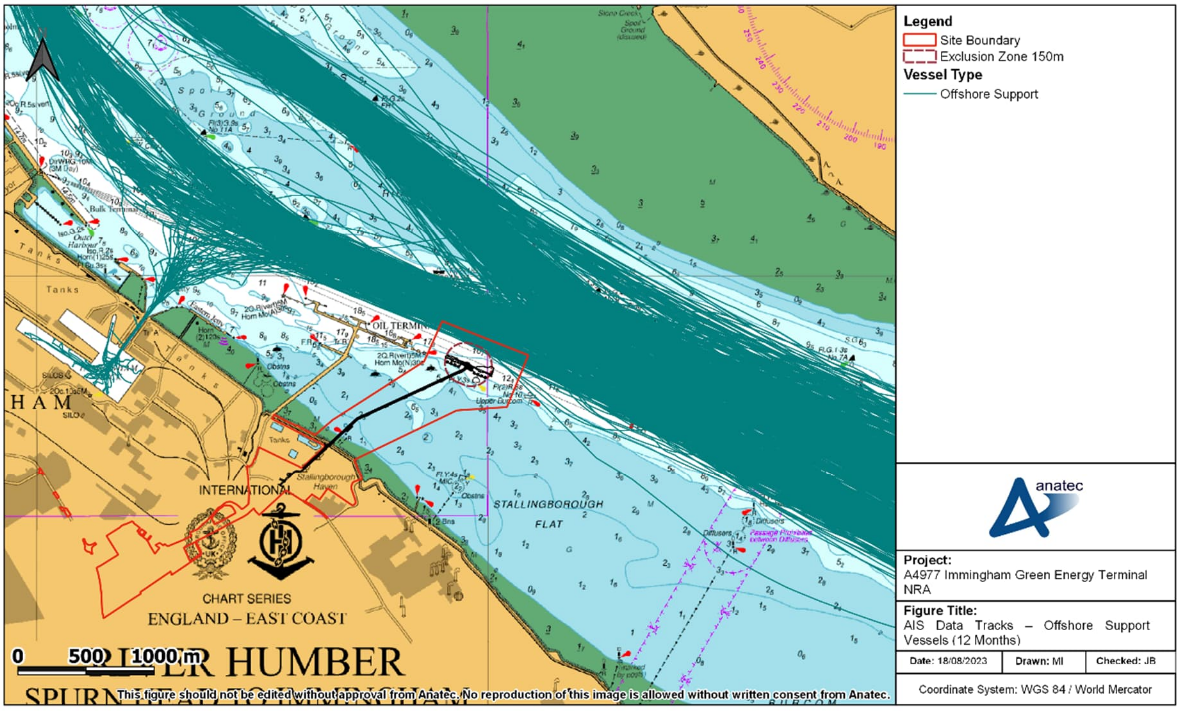

Figure 5.17 AIS Data Tracks – Offshore Support Vessels (12 Months)

It can be seen that offshore support vessels were transiting through the study area via the main channel and Foul Holme Channel. The majority of offshore support vessel tracks recorded were less than 30m in length.

5.5.8 Recreational Activity

Figure 5.18 shows the recreational vessel transits through the gate during the 12-month period, which represented 1% of the overall distribution. It is noted that it is not compulsory for recreational vessels to broadcast on AIS, and therefore, numbers may be under-estimated.

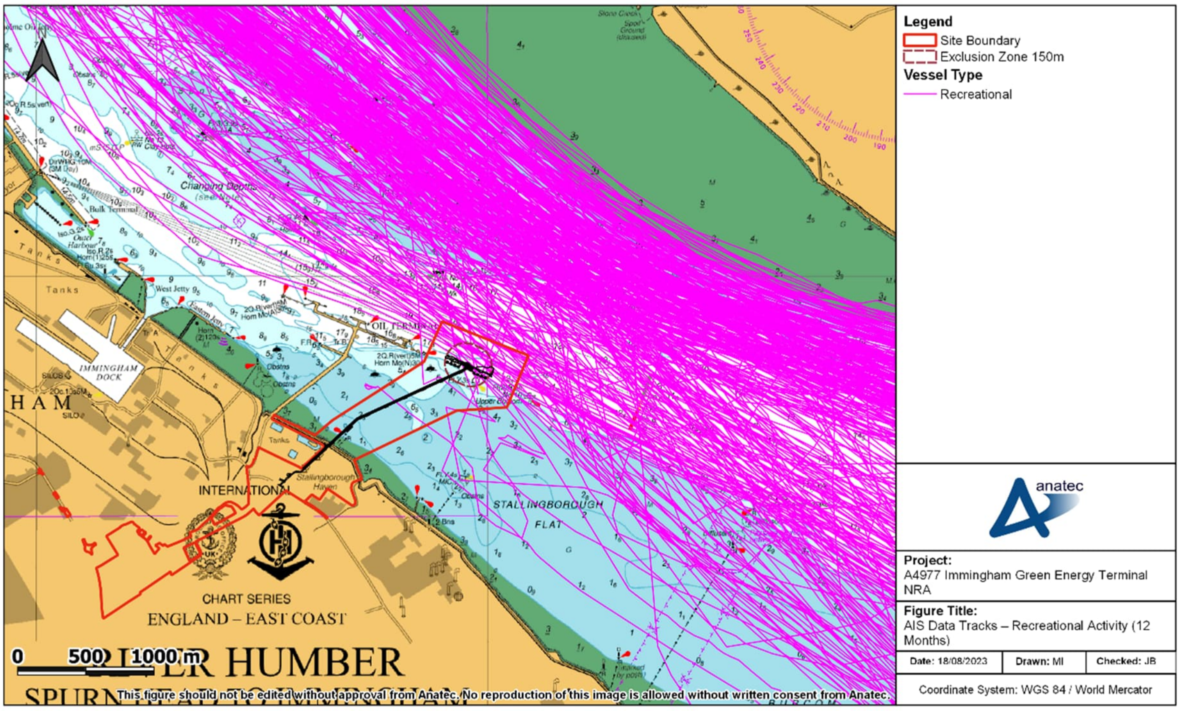

Figure 5.18 AIS Data Tracks – Recreational Activity (12 Months)

During the 12-month study period, recreational activity peaked during the summer months of July and August, with a record of two vessel transits per day on average, during each month. During winter, there was an average of less than one vessel per week.

5.6 Time / Tidal Analysis

The hourly crossings for the entire 12-month period are presented in Figure 5.19.

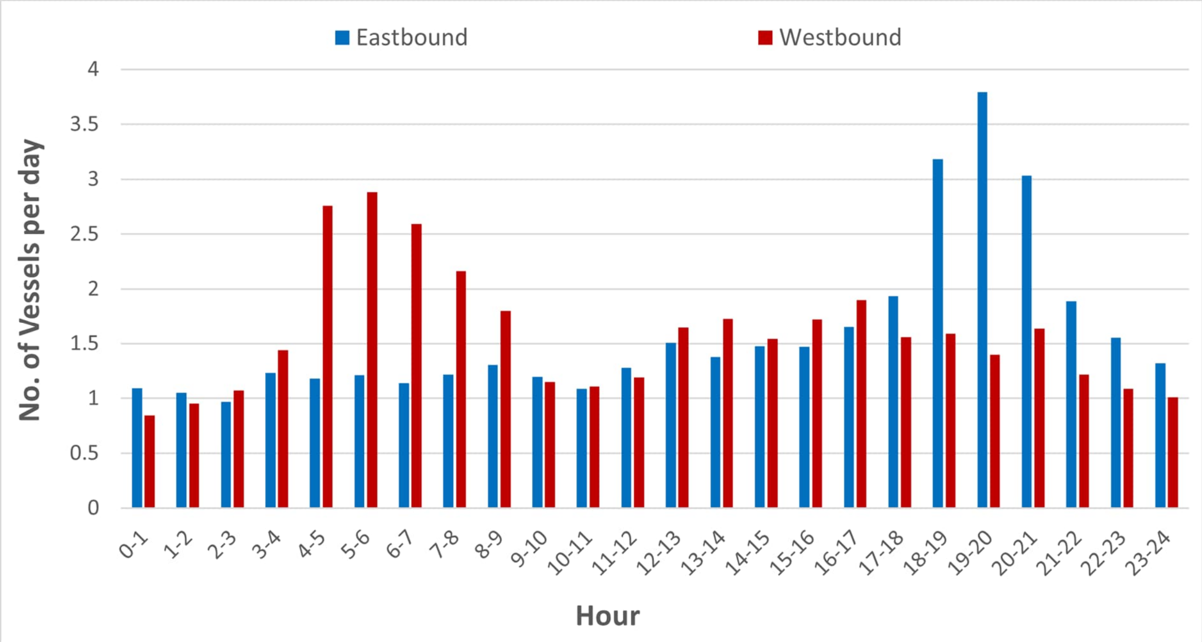

Figure 5.19 Average Hourly Passages by Direction (12 Months)

When averaged over the year, the hourly number of vessels crossing the gate was three (combined by direction).

A peak in the number of vessel transits was noted between 0400-0800 hrs for inbound (westbound) vessels, and between 1800-2100 hrs for outbound (eastbound) vessels. This was mainly due to routine traffic i.e., regular ferries operating on a set timetable regardless of the tide. On individual days, there also tends to be a peak around the times of High Water which dictate when larger vessels are berthed.

5.7 Traffic crossing the Project

This section summarises vessels that crossed the area of the Project infrastructure, including the 150 m exclusion zone to the north. This traffic would be displaced by the Project.

Overall, there was an average of 10 vessel transits per day crossing the Project infrastructure including exclusion zone (compared to 78 per day using the entire width of the river at this point). The type distribution is presented in Figure 5.20.

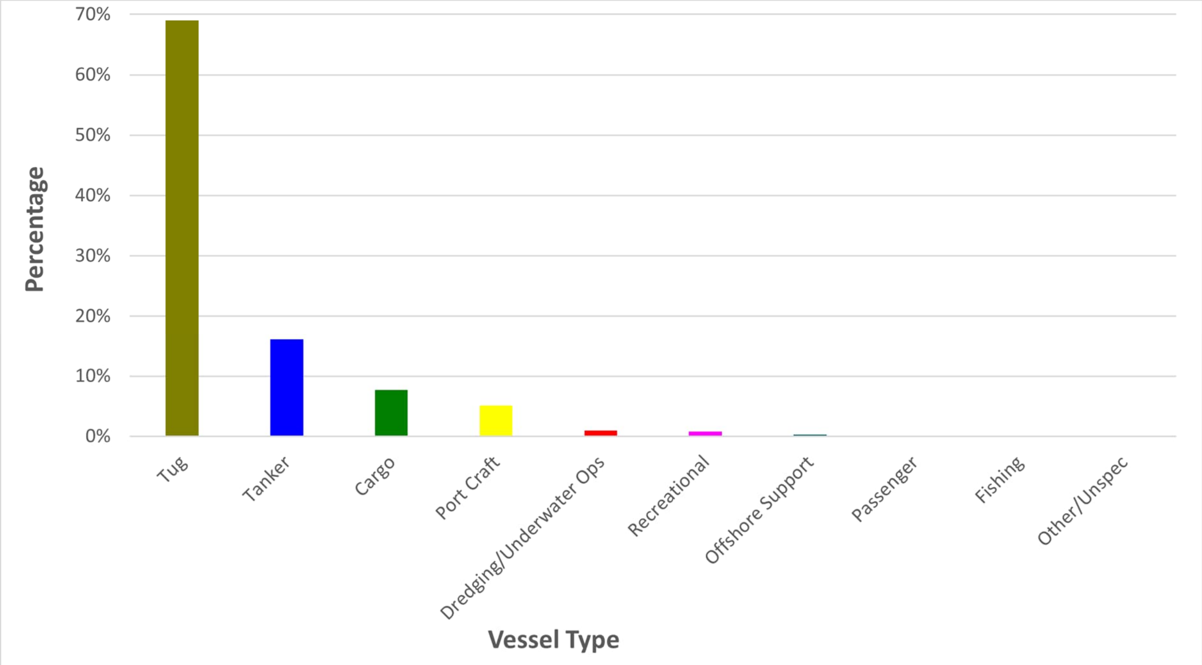

Figure 5.20 Vessel Type Distribution Crossing Project Infrastructure including Exclusion Zone (12 Months)

The most common vessel types recorded crossing the project infrastructure (as well as the exclusion zone), were tugs (69%), followed by tankers (16%), cargo vessels (8%) and port service crafts (5%).

The largest tug recorded was a 35m fire-fighting tug that crossed the northern edge of the exclusion zone. This is a non-routine tug recorded in the study area for four days during the 12 month period.

For the vessels broadcasting as tankers on AIS, only tank barges were recorded south of the berth line. These ranged from 50m to 70m in size. Oil/chemical tankers, product tankers and gas carriers, were observed crossing the northern part of the 150m exclusion zone, with sizes ranging from 79m to 274m.

Cargo vessels transited north of the berth with a small fraction of the overall cargo traffic in the river intersecting the 150m exclusion zone.

Port service crafts were recorded transiting both south and north of the berth. These were mainly small research/survey vessels, and multipurpose workboats.

6 Maritime Incidents Review

6.1 Introduction

This section presents analysis of historical marine accident data for the wider study area over a 10-year period (2012 to 21) based on the following sources:

- MarNIS (Port Risk Management Software by ABP Humber);
- Royal National Lifeboat Institution (RNLI); and
- Marine Accident Investigation Branch (MAIB)

The reporting requirements vary between the sources, with MarNIS being the most comprehensive (including near misses), and MAIB tending to only cover more serious incidents.

6.2 MarNIS

Figure 6.1 shows a summary of yearly fluctuations within the study area, based on the MarNIS data. Incidents are divided by port – HES or Immingham.

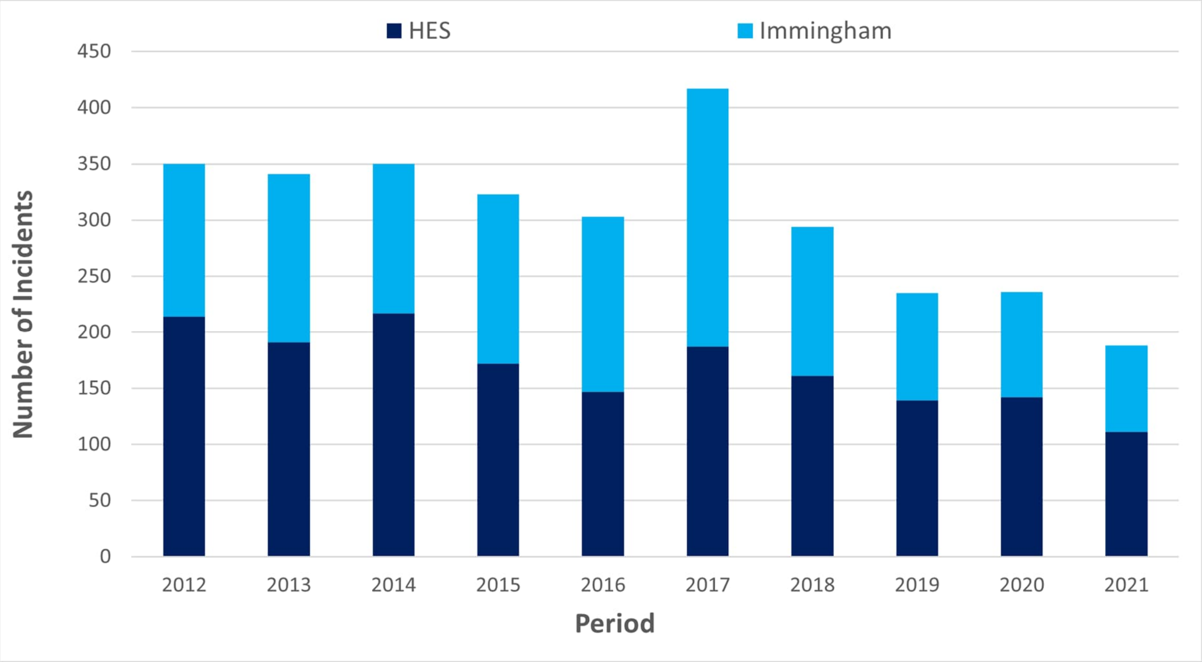

Figure 6.1 Number of Incidents based on MarNIS Data (2012 - 2021)

An average of 304 incidents per year were recorded by the MarNIS. It is noted that this includes both actual incidents and near misses. The overall trend is downwards although not in a straight-line, for example, there was an increase in 2017 due to pilot ladder defects and weighted heaving lines being a focus area for the port, resulting in increased reports. The Port has advised that 2022 has a similar pattern of incidents.

The overall downward trend in incidents correlates to an overall reduction in the number of vessel arrivals for the Humber Estuary in recent years (see Section 8.2).

Figure 6.2 summarises the MarNIS incidents recorded from 2012 to 2021 by type. The 'other' incidents included delays caused by weather, issues with availability of berths, damaged cargo etc.

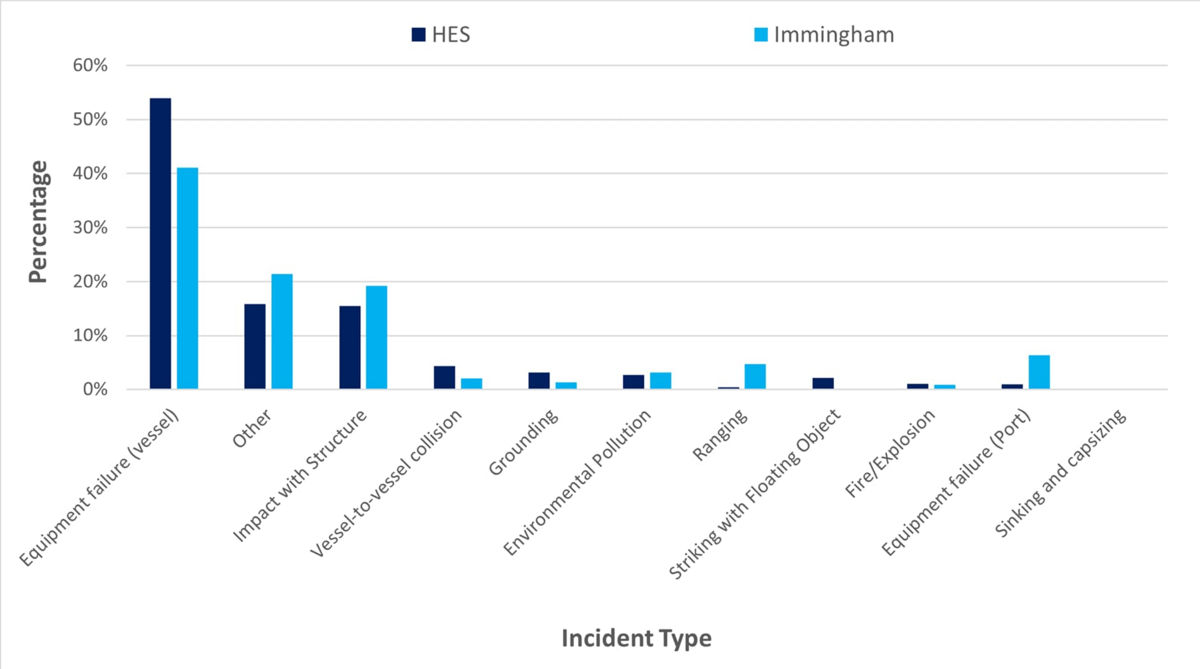

Figure 6.2 MarNIS Incidents by Type (2012 – 2021)

The most common incident reported for both HES and Immingham was equipment failure in vessels, 54% and 41% respectively. Other common incidents, excluding 'other' incidents, were collision with third-party vessels and impact with port infrastructure.

There were two sinking and capsizing incidents recorded in HES, but none in the Immingham dataset. The incidents were recorded in 2018 and 2019, both resulting in no casualties.

Seven incidents were recorded by MarNIS within the site boundary between 2012 to 2021, presented in Figure 6.3.

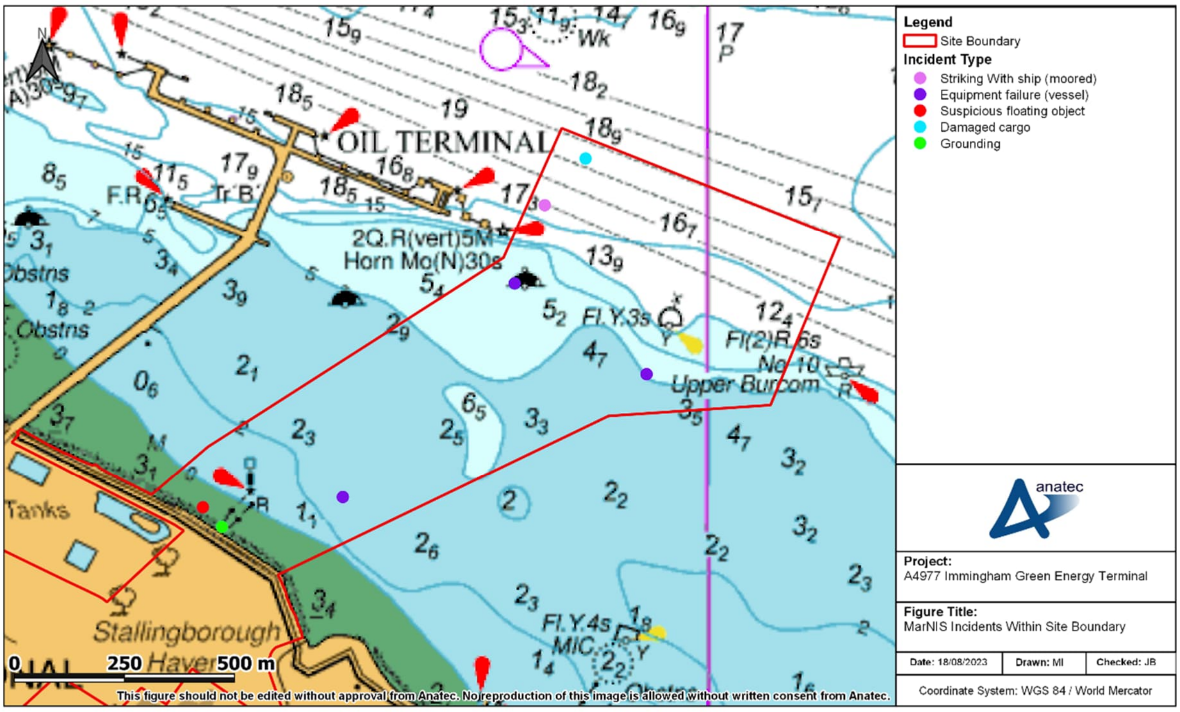

Figure 6.3 MarNIS Incidents within Site Boundary

Out of seven incidents, three were due to equipment failure in vessels. All incidents resulted in little/no damages and no casualties.

There were 126 MarNIS incidents recorded within 150m of IOT, with 24 recorded in vicinity of IOT Berth 3. Out of 126 incidents, 54 were due to equipment failure (vessels and port combined), 25 were impact with structure, and one collision with third party vessels. It was noted that the number of incidents in close proximity of IOT has been reducing, with only eight incidents recorded in 2021. The highest number of incidents is 19, recorded in 2013 and again in 2017.

6.3 RNLI

Figure 6.4 shows a summary of yearly fluctuations within the study area, based on the RNLI data.

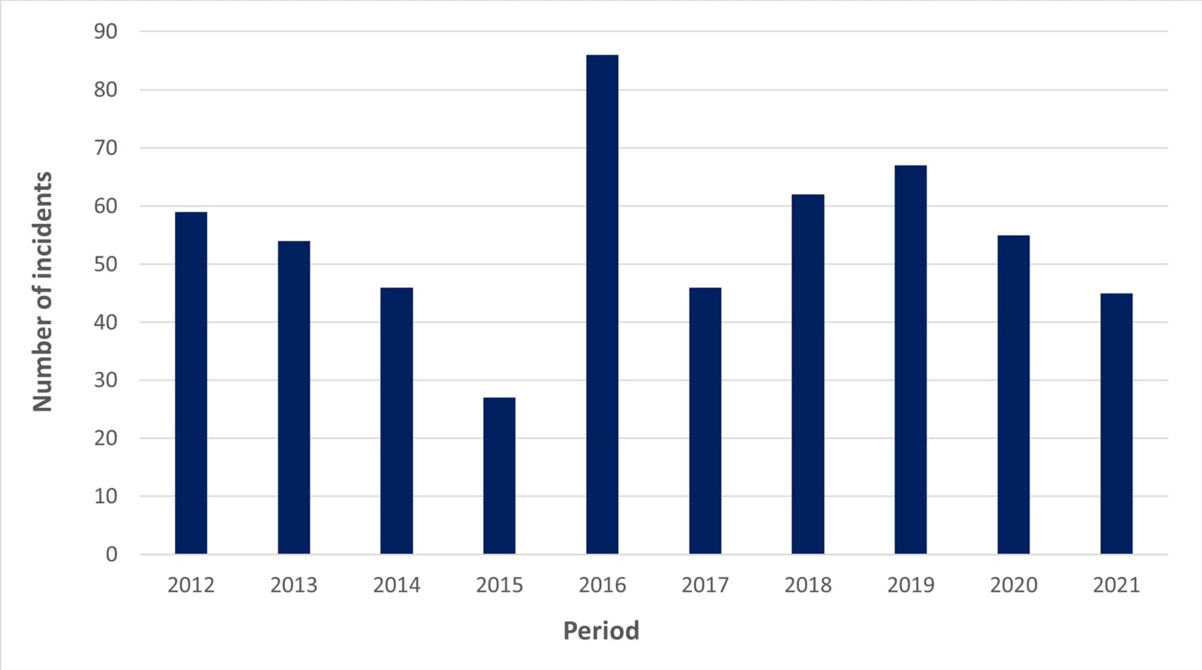

Figure 6.4 Number of Incidents based on RNLI Data (2012 - 2021)

An average of 55 incidents per year were recorded by the RNLI. Most of the recorded incidents were due to equipment failure, grounding, sailing failure (recreational activity) and collision. The incidents that were recorded in proximity to the Project were responded to by the Humber Lifeboat Station. The Cleethorpes station was also involved in responses to incidents farther east, near Grimsby.

A significant increase in incidents was noted in 2016 due to a large number of ‘person in danger’ incidents recorded nearshore.

There were no incidents recorded by RNLI within the site boundary.

6.4 MAIB

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

Figure 6.5 shows a summary of yearly fluctuations within the study area, based on the MAIB data.

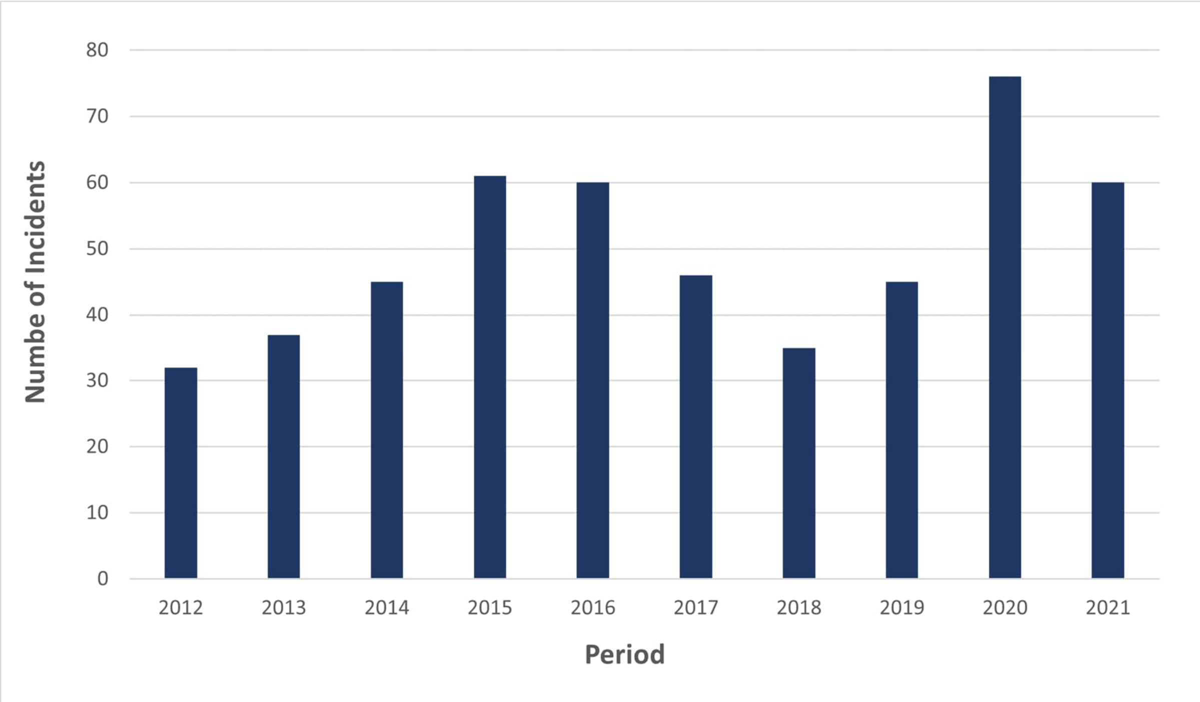

Figure 6.5 Number of Incidents based on MAIB Data (2012 - 2021)

An average of 50 incidents per year were recorded by the MAIB.

Most of the recorded incidents were due to grounding, equipment failure, collision with port infrastructure and loss of control. Collisions were more commonly noted in close proximity of the ports; Hull, Grimsby and Immingham.

Only one incident was reported within the site boundary in the MAIB dataset, during the 10-year period. It was classified as an 'accident to person', with little to no damage to the 34m long tug (towing vessel), and no casualties.

7 Marine Development

7.1 Introduction

The specifications of the marine infrastructure associated with the proposed development, how it will be constructed, and its operational purpose is described in detail in Chapter 2: The Project and Chapter 3: Needs and Alternatives of the ES [TR030008/APP/6.2] for the Project. This section of the NRA summarises the features which are of most relevance to the NRA.

7.2 Marine Works

The Terminal would comprise the construction of a new jetty located in the Humber to the east of the existing Immingham Oil Terminal jetty. A single berth is proposed that would have the capacity to facilitate the import and export of bulk liquids associated with the energy sector. The berth would be capable of handling a variety of vessels, of between 100m - 250m in length over all (LOA) with draughts of up to 12.8m. The associated hydrogen production facility, to be operated by Air Products and described below, would be the first user of the jetty facility for the import of green ammonia to be converted to green hydrogen. The other bulk liquids are expected to include products such as liquefied CO2 for the purpose of carbon capture and storage via connection to proposed CO2 transport infrastructure being developed close to the Port.

The proposed marine infrastructure for the terminal would consist of the following components:

- An open piled jetty approach trestle, up to 1.2km in length, which would extend from the river frontage in a northerly direction leading to the jetty structures and which would provide access for vehicles and pipework to and from the shore to the berth. The approach trestle would be 14m wide for the main length with increased widths of 17m and 26.6m for passing places and an operations building respectively.
- The jetty head would comprise structures including (un) loading platforms with mechanical loading arms, two breasting dolphins with fenders and eight mooring dolphins linked by high level walkways to facilitate operational and maintenance access.
- A temporary refuge shelter to provide a safe and secure area for personnel in the event of an emergency, although this may be incorporated into the jetty head building.
- Appropriate topside infrastructure installed on the jetty to load and unload vessels including marine loading arms, quick release hooks, control building, gangway, piping, wastewater collection and drainage and supporting utilities for handling liquid bulk shipments. The pipework would run along the jetty, over the existing seawall, to a connection point with the landside pipework.
- The construction of lighting infrastructure, and utilities (electrical systems, firewater systems, communications systems, security systems).

- A capital dredge of approximately 4,000m³ (based on the latest available site-specific geotechnical and geophysical information) would be required to ensure accessibility and safe mooring for vessels on the berth at all states of the tide. The required dredge depth would be approximately 14.5m below Chart Datum (CD).
- Periodic maintenance dredging may be required typically using cutter suction dredging. This would be undertaken alongside existing maintenance dredge operations undertaken by the Applicant.
- Dredged arisings would be disposed of at licensed sites within the estuary.

7.3 Construction Phase

7.3.1 Marine infrastructure

Some marine construction works would likely be undertaken from the shoreside to form the jetty connection from the land to sea. The extent of work which would be conducted from the shore side would be determined by the proximity in which a jack-up barge can be brought alongside the existing seawall.

In the marine environment, the structures would rest upon an open piled network of steel tubular piles likely to be driven by vibro and percussive piling techniques. The deck for the approach trestle and jetty would be supported by either a precast or in-situ concrete deck. The topside pipework would be fabricated off-site in modules and lifted into position. The high-level walkways between dolphins would be fabricated off-site and lifted into position. Overwater working would be strictly controlled in accordance with Port safety operations.

7.3.2 Capital Dredging

The capital dredge methodology is anticipated to be backhoe dredge with split hopper barge. Dredge operations would be continuous and operate 24 hours a day and seven days a week.

Dredging of up to 4,000m³ of material would be required. This in-situ volume is predominantly flat alluvial deposits such as unconsolidated material (silts, sands, and gravel) of up to 3,900m³, and consolidated material (e.g., glacial till with limited chalk inclusion) of up to 100m³.

7.3.3 Disposal of Dredge Material

It is expected that the chalk and other dredge arisings would be disposed of at licenced sites within the estuary, at Holme Channel disposal site (HU056) to dispose of consolidated material, and Clay Huts disposal site (HU060) to unconsolidated material.

7.3.4 Construction Vessels and Activities

During the construction of the jetty, there would be a requirement for multiple marine vessels. Piling operations would be undertaken from the jack-up barges; the number of barges used would be dependent upon the construction programme and work sequencing, however, it is envisaged that up to two barges would be used for the piling works.

The jack-up barge would be supported by fleet of support vessels which would include:

- Tugs (likely 1) used for repositioning the barge(s) into new pilling locations and for moving flat top supply barges from marine load-out to the work location.
- Multi-cats (likely 2) used to resupply the barge(s) with piles, plant, consumables and associated jetty fabrications.
- Flat top barges (likely 3) used to transport equipment to the work area, house plant etc.
- Floating barges (likely 2) with a crane used to undertake lifting operation.
- Safety boat (likely 1) used to support operations and assist with crew transfers.
- Dredging vessels formed of backhoe dredger and split hopper barges.

During the jetty construction, it is anticipated that the tug, multi-cat vessels and a safety boat would be operating in the construction area daily. It is anticipated that multiple barge moves would be undertaken each week.

7.3.5 Marine Construction Lighting

During marine construction works, various forms of lighting would be required to safely undertake the works. All support vessels and barges would use navigational lights to ensure they can be seen by other vessels. This lighting would be required at all times. Additionally, the support vessels and barges would require general lighting during operational hours.

Task lighting would be used by the vessels and barges during operational hours to suitably illuminate the working area(s), for example, the pile gates during piling works and areas of the piles where lifting operations are being conducted.

7.3.6 Construction Working Hours

It is anticipated that night time piling restrictions will apply to percussive piling works within the water body seaward of marine highwater mark outside the hours of sunrise and sunset in certain summer months (June and August) and between 19:00 and 07:00 in certain winter months (March, September and October) seven days a week. Other marine construction, including dredging, are assumed to be undertaken on a 24-hour basis and continue until completion for safety or quality reasons.

7.4 Operational Phase

The Terminal would operate 24 hours a day, seven days a week and 365 days a year. The Terminal would have capacity to accommodate up to 292 vessel calls per year and it is anticipated that up to 12 of these calls would be ammonia carriers associated with the hydrogen production facility. The total vessel numbers have been assessed as the worst-case scenario in terms of potential navigational effects.

During operation of the Project, periodic maintenance dredging of the berthing pocket of the jetty would be required. The overall volumes of the maintenance dredging associated with the Project would be very small (if required at all) compared to that of the capital dredge.

8 Future Baseline

8.1 Introduction

The characterisation of vessel traffic established in the baseline (see Section 4.8) is used as input to the risk assessment. However, it is also necessary to consider potential future case vessel traffic, in terms of general volume and size changes, and other port developments which may influence traffic movements.

8.2 Tonnage and Vessel Numbers

The future growth and development of ports and shipping is inherently linked to trade patterns and the economic climate and is reactive to changing economic circumstances. Economic growth and increases in world trade results in higher levels of shipping and growth of port operations. Conversely, economic slowdown and recession result in lower levels of global trade and of shipping. Ultimately, as global and local populations continue to rise, the economy is expected to grow to facilitate this.

The timeframe for the future baseline has been set at 50 years. Fifty years was defined as the lifetime of the entity for the purposes of the risk assessment, over which period there is the greatest potential for changes to traffic levels. It is noted the Project infrastructure will continue to be used beyond the engineering design standard of 50 years. In practice, the Project marine infrastructure will become an integral part of the port's infrastructure, being maintained, and renewed over the ensuing years as appropriate and as is already the case with similar infrastructure within the Port.

In establishing a future baseline for this timeframe, global and local contexts have been taken into account so as to be able to anticipate changes caused for example, in shipping trends or by estuary constraints etc. Thus, potential changes in shipping can be assessed by reviewing vessel trends at ports on the Humber and then placing the resulting data in the context of national shipping trends (Ref. xii). The final stage is then to review the data results in the wider context of the global change in the economy by considering population change both locally and internationally. The future baseline can also be anticipated by considering if any local (estuary) geomorphological constraints prevent maximum vessel size increasing above a certain threshold.

Table 8.1 reflects changes that have occurred over the past 50 years in a local context. It indicates that the peak of maritime trade on the Humber Estuary was in 2019 with a total of 78.3 million tonnes. This is over double the freight tonnage movements that were recorded in 1970. This increase in trade rate closely correlates with the increase in global population over this time from 3.7 billion to 7.8 billion at a rate of 2.1 times.

The data in Table 8.2 demonstrates all UK port freight in ten-year increments and as annual statistics since 2016. The trend seen is a far more gradual increase in trade for the whole of the UK. Furthermore, this data suggests that the national peak for trade via shipping was some 15-20 years earlier than the historic peak experienced on the Humber Estuary as displayed in Table 8.1. It should also be noted that Northern Ireland data was incorporated from 1980, however from 2017, a change in the coverage of smaller ports was made (i.e., smaller port reporting now not included) reducing the total observed in this data set.

Table 8.3 considers the change in the number of ship arrivals at principal ports in the Humber Estuary since 1995. The data in this table shows a peak occurring around the mid-2010s reducing slightly prior to the change of coverage observed in 2017. Of particular interest is the data for Grimsby and Immingham, which shows that over the past 27 years the highest number of vessel arrivals in a calendar year was just under 9,000 recorded in 2015.

Table 8.4 considers 10 years of annually occurring data for all vessel arrivals at UK ports.

Table 8.1 shows a relatively stable tonnage level between 2010 and 2019 with values ranging between 76 to 78 million tonnes. A decrease was noted in 2020 and 2021 due to COVID impacts, but still recorded 72 and 71 million tonnes, respectively. Table 8.3 identifies over the same time period a reducing trend in vessel numbers from 11,467 in 2010 to 9,404 in 2021. This is a 25% decrease in shipping arrivals over the past 10 years (2012 -2021), compared to a relatively stable tonnage volume. This indicates that vessels are transporting more tonnage per vessel move, which can be assumed to be an increase in carrying efficiency and/or an increase in vessel size. This suggests that less frequent but larger vessels are becoming more commonplace as time goes on which tracks with other international shipping indicators. Table 8.2 shows a similar trend, with tonnage level gradually reducing from 512 million tonnes in 2010 to 446 million tonnes in 2021. Table 8.4 identifies over the same time period, a reducing trend in vessel numbers from 274,266 in 2010 to 195,976 in 2021. This is a 29% decrease in vessel traffic in the past 12 years, compared to a 13% decrease in tonnage handled by UK ports. This reiterates that vessels are transporting more tonnage per vessel move.

In considering these tables and their most recent data, a number of geopolitical and international considerations must be taken into account, most particularly, the impacts of the COVID-19 pandemic and the European Union transition period. This is notable in the 2020 and 2021 statistics. If tonnage handled by the Humber Estuary remains relatively stable, as it has over the last 10 years, with ship size increasing gradually, it is likely that vessel movement totals will continue to gradually reduce. That said, the physical features of the Estuary may limit further ship size increases which could cause vessel totals to plateau (if tonnages remain at current levels).

Table 8.1 Humber Estuary Freight Tonnage (millions of) Traffic by Port

Ports	Ten Yearly					Annual					
	1970	1980	1990	2000	2010	2016	2017	2018	2019	2020	2021
Goole	2.2	1.4	1.7	2.7	1.9	1.4	1.4	1.5	1.2	1.0	1.2
Grimsby and Immingham	23.7	22.2	39.4	52.5	54.0	54.4	54.0	55.6	51.2	45.6	50.0
Hull	7.2	3.8	6.8	10.7	9.2	10.2	9.8	9.8	9.2	9.2	9.4
River Trent	0.0	2.3	3.2	2.5	1.4	1.3	1.1	1.1	1.0	1.0	1.0

Rivers Hull and Humber	0.0	4.1	7.6	9	10.0	10.2	9.9	10.1	10.7	10.5	9.6
Dutch River Wharf	0.0	0.0	0.0	0.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
River Ouse	0.0	0.5	1.0	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Total Tonnage	33.1	34.3	34.3	59.7	77.7	76.7	77.7	76.4	78.3	72.4	71.3

Table 8.2 All UK Port Freight Tonnage (millions of) Traffic by Direction

Direction	Ten Yearly					Annual					
	1970	1980	1990	2000	2010	2016	2017	2018	2019	2020	2021
Inwards	257	223	278	316	313	303	301	310	312	279	292
Outwards	113	201	214	257	199	181	181	173	170	160	154
All	370	424	492	573	512	484	482	483	482	439	446

Table 8.3 Humber Estuary Major Port Ship Arrivals

Ports	Five Yearly					Annual					
	1995*	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Goole	1,317	1,342	1,282	932	655	717	718	725	617	533	582
Grimsby and Immingham	6,949	7,030	8,720	7,923	8,959	8,548	7,912	7,197	7,126	6,511	6,636
Hull	4,379	3,821	3,632	2,612	2,719	2,568	2,760	3,217	3,081	2,478	2,186
Total	12,645	12,193	13,634	11,467	12,333	11,833	11,390	11,139	10,824	9,522	9,404

*Earliest year available in the data record

Table 8.4 UK Port Vessel Arrivals (thousands of)

	2010	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total	274.3	265.3	259.4	262.8	260.8	253.8	227.2	226.3	220.9	188.7	196.0

8.3 Future Baseline Without Scheme

8.3.1 General Growth

The global population is modelled to increase from 7.95 billion in 2022 to 10.5 billion in 2072 based on the current average cumulative population increase of ~1-2% per annum. This growth is considerably less than the growth seen in the past 50 years (~2.1%) and as result global economies are not expected to grow by the same factor as they did in the latter half of the 20th century (Ref. xii). It is reasonable to assume that a growth in the economy will likely lead to a greater tonnage of freight moving through the Humber Estuary. A conservative metric for determining a potential future baseline has been adopted by projecting from 2019 at 1% cumulative growth in tonnage as shown in Table 8.5.

Table 8.5 Future baseline for 1% Growth

Year	Grimsby and Immingham Tonnage (mil)	UK Total Tonnage (mil)	Grimsby and Immingham Arrivals
2019	51.2	482.0	7,126
2022	52.8	496.6	7,342
2030	57.2	537.8	7,950
2040	63.2	594.0	8,782
2050	69.8	656.2	9,701
2060	77.1	724.8	10,716
2070	85.1	800.6	11,837
2072	86.8	816.7	12,075

8.3.2 IERRT Vessel Traffic

There are a number of cumulative projects considered in Chapter 25: Cumulative and In-Combination Effects of the ES [TR030008/APP/6.2], which could influence future traffic to/from the Humber. The most significant in terms of the Project is the Immingham Eastern Ro-Ro Terminal (IERRT), which is planned to be a new roll-on/roll-off facility comprising a new jetty with three berths to be located to the west of the Project. As it is a known planned scheme which could increase vessel traffic passing in proximity to the Project, it has been considered in more detail below.

The construction of the marine infrastructure will generate marine works traffic for a period of approximately 18 months (for single stage construction) or approximately three years (for a sequenced construction scenario). This marine traffic will include work boats, barges, tugs, and other works craft.

The operational phase will see an increase in Ro-Ro vessel arrivals for this location on the Humber of three vessels per day. In addition, these vessels may on occasion require tugs, line handling/mooring vessels as required, as well as annual maintenance dredging.

8.4 Conclusion

Economic growth over the next 50 years, as well as vessel traffic due to specific projects such as IERRT discussed in Section 8.3.2 (and the Project as discussed in Section 2.3), could increase the number of vessel movements to and from the Humber (in particular, Immingham). This has been considered in the hazard review, noting that the Port has spare capacity relative to historical peaks in vessel arrivals.

9 NRA Methodology

9.1 Introduction

The International Maritime Organization (IMO) Guidelines for Formal Safety Assessment (FSA) defines a hazard as: "A potential to threaten human life, health, property or the environment" (Ref. v). This statement identifies the potential event that has an undesirable outcome on four defined receptors. The potential for a hazard to be realised can be combined with an estimated (or known) consequence and frequency. This combination is termed 'risk'. Risk is a measure of the frequency and consequence of a particular hazard. The methodology applied within this NRA evaluates and records the risk by utilising a matrix approach using the four receptors of people, property (i.e., damages), planet (i.e., environment), and port (i.e., business and reputation).

This NRA has been undertaken to determine the risk to marine and navigation associated with the proposed development (as described in Section 7). To do so, the potential hazards of the proposed Project design (base case) have been assessed in the context of the potential impacts that may arise during:

- Construction: construction of the jetty, including capital dredging and installation of infrastructure; and
- Operation: change to the study area's vessel movements including any maintenance dredging.

The methodology applied for carrying out this NRA follows and complies with the guidance from the PMSC 'A Guide to Good Practice on Port Marine Operations' (Ref. iv). Additionally, IMO FSA (Ref. v) has been taken into account for guidance on the hazard categorisation and analysis stages. The following identifies the steps required for carrying out marine hazard identification and the risk analysis process:

1. Identification of hazard (listing of potential marine hazard scenarios, describing hazard descriptions and outcomes).
2. Risk analysis (determination of frequency and consequence for each hazard scenario).
3. Risk assessment and control options (consideration of existing (embedded) mitigation measures, which either reduce the outcome frequency or control the severity or both; and potential risk controls, which are not currently in place, but could be used to further reduce or eliminate risk).
4. Cost-benefit assessment (an evaluation of the time, cost, and physical difficulty of taking the measures identified to avoid or reduce the risk).
5. Recommendations for decision-making (final decisions in determining risk made by the Duty Holder).

The following sections identify the outcome from the above steps, carried out within this NRA.

9.2 Stage 1: Hazard Identification

When considering the introduction of new, or alterations to, port infrastructure, a collective process is required to identify new or altered hazards created by new trade or by the changes likely to arise in connection with marine operations. An incident may occur if new or altered port infrastructure and its associated trade has not been evaluated and all risks managed as far as reasonably practicable.

ABP, as the Harbour Authority, manages changes to port development and the introduction of new trade through risk-based evaluation and established risk controls, with the application of appropriate additional risk mitigation measures in accordance with the PMSC (Ref. iii) and the GtGP (Ref. iv). This forms the basis of the risk assessment methodology.

Within the process of hazard identification and risk assessment, ABP take fully into account the relationships between the Statutory Harbour Authority, the port authority, terminal operators, and relevant vessel operators. The GtGP recommends that: "*structured meetings need to be held during this process involving relevant marine practitioners at all levels*", (Ref. iv). Port users need to be invited to take part in these meetings, including groups such as Pilots and Pilotage Exemption Certificate (PEC) holders, commercial operators, tug operators, crew and other regulators and agencies. This stage of the process is termed the 'Hazard Identification' (HAZID) and may take the form of one or more sequenced meetings. Broad hazard categories are used to group different hazard scenarios.

In the case of this NRA exercise, potential hazard have been identified during the Scoping, PEIR and EIA stages, based on analysis of vessel activity and historical incident data, maritime experience, and consultation with relevant stakeholders.

The use of expert judgment is an important aspect of the HAZID. In applying expert judgment, different experts may be involved in a particular NRA. It is unlikely that the experts' opinions will be in agreement. It might even be the case that the experts have strong disagreements on specific issues. However, it is the goal of each HAZID to reach a position of consensus. If this is not possible, the degree to which opinions differ needs to be considered.

This stage also highlights the potential outcomes and consequences if each of the identified hazards were to occur. This process follows the GtGP as a useful way to consider hazard scenarios the 'most likely' and the 'worst credible' outcomes.

The GtGP states: "This approach provides a more realistic and thorough assessment of risk, which reflects reality, in that relatively very few incidents result in the worst credible outcome. On a 5 x 5 risk matrix used by many organisations, these incidents score highly for consequence, but this is tempered by a low score on the frequency axis" (Ref. iv).

The output of this stage is the initial listing for a Hazard Log, listing hazards caused or changed by new or altered port infrastructure.

9.3 Stage 2: Risk Analysis

The GtGP states that: "Hazards need to be prioritised. A method which combines an assessment of the likelihood of a hazardous incident and its potential consequences should be used. This is likely to be a matter of judgement best taken by those with professional responsibility for managing the harbour", (Ref. iv).

Subject matter experts and local port users in attendance at the HAZID workshop(s) contribute to the formation of the hazard scenario with descriptive and tailored 'worst credible' and 'most likely' events which are then assessed against four receptors, namely:

- People (human life/personal injury);
- Property (port and shipping infrastructure damage).
- Planet (environment); and
- Port (reputation/business/amenity loss).

For each hazard scenario eight outcomes are therefore determined. This is comprised of four outcomes from the 'worst credible' description and four outcomes from the 'most likely' description for each receptor. These outcomes are identified from the frequency and consequence criteria determined post-HAZID. The outcome categories are assigned through the matrix shown in Table 9.4 and these categories are used to calculate risk as above.

9.3.1 Consequence Descriptors

The consequence descriptors (as defined within ABP's Marine Safety Management System's consequence categories) are used to inform the assignment of values to the hazard scenarios within the Hazard Log. The associated descriptions detailed below in Table 9.1 to ensure that outcomes are applied consistently in contemplation of the severity of the consequence should it actually occur.

Table 9.1 Severity of Consequence Ranking Definitions

Rank	Description	Definition			
		People	Property	Planet	Port (Business)
1	Negligible	No injury	Negligible (£0 - £10,000)	None (No incident - or a potential incident/near miss)	None
2	Minor	Minor injury(s)	Minor (£10,000 - £750,000)	No Measurable Impact (An incident or event occurred, but no discernible environmental impact - Tier 1 but no pollution control measures needed)	Minor (Little local publicity. Minor damage to reputation. Minor loss of revenue, £0 - £750,000)

Rank	Description	Definition			
		People	Property	Planet	Port (Business)
3	Moderate	Serious injury(s) (MAIB/RIDDOR reportable injury)	Moderate (£750,000 - £4M)	Minor (Incident results in pollution with limited/local impact - Tier 1, Harbour Authority pollution control measures deployed)	Moderate (Negative local publicity. Moderate damage to reputation. Moderate loss of revenue, £750,000 - £4M)
4	Major	Single fatality	Serious (£4M - £8M)	Significant (Has the potential to cause significant damage and impact - Tier 2, pollution control measures from external organisations required)	Serious (Negative national publicity. Serious damage to reputation. Serious loss of revenue, £4M - £8M)
5	Extreme	Multiple fatalities	Major (> £8M)	Major (Potential to cause catastrophic and/or widespread damage - Tier 3, requires major external assistance)	Major (Negative national and international publicity. Major damage to reputation. Major loss of revenue, > £8 M)

9.3.2 Frequency Descriptors

The frequency descriptors are used to inform the assignment of values to the hazard scenarios within the Hazard Log. The associated descriptors and indicative return periods detailed in Table 9.2 ensure that values are applied consistently. The lifetime of the entity is taken as 50 years.

Table 9.2 Frequency of Occurrence Ranking Definitions

Rank	Description	Definition	Indicative Return Period
1	Rare	The impact of the hazard is realised but should very rarely occur (within the lifetime of the entity)	> 1,000 years
2	Unlikely	The impact of the hazard might occur but is unlikely (within the lifetime of the entity)	100-1000 years
3	Possible	The impact of the hazard could very well occur, *but it also may not* (within the lifetime of the entity)	10-100 years
4	Likely	It is quite likely that the impact of the hazard will occur (within the lifetime of the entity)	1- 10 years

5	Almost Certain	The impact of the hazard will occur (within lifetime of entity)	< 1 year

9.3.3 Risk Evaluation

The risk classification associated with each of the hazard scenarios is then assessed to a pre-defined scale shown in Table 9.3. In the context of marine safety, it must be remembered that the overriding objective identified in the PMSC is to reduce risk to a point which is 'as low as reasonably practicable' (ALARP).

Table 9.3 Risk Classification

Classification	Outcome
Very High Risk	Very High
Significant Risk	Significant
Medium Risk	Medium
Low Risk	Low
No Practicable Risk	No Practicable Risk

The associated five-by-five risk Matrix is provided at Table 9.4.

When using this risk matrix in combination with the consequence and frequency descriptors (Table 9.1 and Table 9.2), the outcome for the receptors of people, property, planet, and port is reached. This outcome is compared with risk tolerability. Any intolerable risk is unacceptable unless sufficient control measures are able to be identified so as to reduce consequence and frequency to a position that is tolerable and ALARP.

Embedded and planned mitigation measures were taken into account as described in the next step.

Table 9.4 Risk Matrix

Frequency	Consequence: Negligible	Minor	Moderate	Major	Extreme
Rare	No Practicable Risk	Low	Low	Low	Medium
Unlikely	Low	Low	Medium	Medium	Medium
Possible	Low	Medium	Medium	Significant	Significant
Likely	Low	Medium	Significant	Significant	Very High
Almost Certain	Medium	Medium	Significant	Very High	Very High

9.4 Stage 3: Risk Assessment and Control Options

Risk assessment necessarily includes a review of existing (embedded) controls as well as potential controls identified. This step allows a broader view of controls, some of which may not have been directly discussed at the HAZID workshop. It is possible that additional controls are identified, which if applied could further reduce the outcome of the risk if applied.

In doing so there is a hierarchy of risk control principles as advised in the GtGP (Ref. iv). These are:

- "Eliminate risks – by avoiding a hazardous procedure or substituting a less dangerous one;
- Combat risks – by taking protective measures to prevent risk;
- Minimise risk – by suitable systems of working. If a range of procedures is available, the relative costs need to be weighed against the degree of control provided, both in the short and long term".

As a result of this additional consideration and feedback, new causes, risk control measures, future mitigations (or changes to existing risk control measures) may also be identified which could trigger an increase or a decrease in hazard scenario risk.

The overall risk exposure of the organisation is considered during this stage with future applicable controls reducing risk to tolerable and ALARP. The outcome from this stage of the process is recorded in the Risk Assessment.

9.5 Stage 4: Cost Benefit Analysis, ALARP and Tolerability

The aim of the risk associated with marine operations in harbours is to reduce it to ALARP. The degree of risk for each hazard scenario can be balanced on the following terms against the time, effort, cost, and physical difficulty of taking measures that avoid the risk. The GtGP states that: "If any of these are so disproportionate to the risk that it would be unreasonable for the people concerned to incur them, they are not obliged to do so. The greater the risk, the more likely it is that it is reasonable to go to very substantial expense, trouble, and invention to reduce it. But if the consequences and the extent of a risk are small, insistence on great expense would not be considered reasonable" (Ref. iv).

An organisation that requires an NRA to determine if an activity can or cannot go ahead, needs to define its position on tolerability. Without this known state of risk acceptance, hazard scenarios (and their associated risk) cannot be determined as tolerable or intolerable. Tolerability must be approached from the perspective of the previously defined receptors of people, property, planet, and port. This is because organisations will have different perspectives on each of the receptors and it is highly unlikely that a risk matrix will be so proportionately balanced that (as an example) the acceptable risk to people (life) aligns with an acceptable risk to property (damage).

Tolerability, therefore, is a requirement of any risk assessment and must be determined by those accountable within the organisation concerned. Specifically, in the case of NRAs the GtGP states that: "Risks may be identified which are intolerable. Measures must be taken to eliminate these so far as is practicable. This generally requires whatever is technically possible in the light of current knowledge, which the person concerned had or ought to have had at the time. The cost, time and trouble involved are not to be taken into account in deciding what measures are possible to eliminate intolerable risk" (Ref. iv).

The purpose of the Cost Benefit Analysis process ensures all risks to an ALARP state. If a risk is intolerable, it is imperative that controls are applied until the risk is both ALARP and tolerable. If, however, the risk is neither ALARP nor tolerable then the given organisation, in this case ABP, will need to review design and operational parameters before re-assessing.

9.6 Stage 5: Decision Making Progress

As part of the Cost Benefit Analysis, the Risk Assessment and Control Options are presented to those who have the appropriate authority to authorise or reject the proposed further applicable controls. This forms the final step of the assessment process. The aim of the previous stage is to reduce risks to ALARP through the addition of further applicable controls.

If risks returned from the Cost Benefit Analysis are both ALARP and tolerable, then the decision-making process automatically recommends that the activity can be approved from a risk-based perspective. If a case occurs where all controls and mitigation measures are applied, and a risk is still intolerable then the organisation cannot proceed with the associated activity.

10 Hazard Identification Workshop

To provide an assessment of navigational risk during the construction and operational stages of the Project, a hazard identification workshop was held on 10 May 2023 in Grimsby with a variety of project personnel, port personnel and external stakeholders.

During the workshop, presentations were given by ABP and Anatec on the project design, available baseline data, and NRA methodology. Additionally, HR Wallingford briefly summarised the findings of the navigational simulation exercises.

After these presentations, discussions took place to identify the potential hazards associated with the proposed development (per phase), the causes of such hazards, and suitable risk control measures.

Following the workshop and agreement of the minutes, the hazards were ranked and the draft rankings were circulated to all attendees for review and comment before being finalised within the Hazard Log as part of the risk analysis process.

The full minutes from the workshop are provided in Appendix A of this report.

11 Hazard Review Summary

11.1 Hazard Scenarios

The hazards scoped into the NRA (from the earlier Scoping and PEIR stages), were reviewed and agreed in consultation with stakeholders at the HAZID workshop. The hazards are listed in Table 11.1, divided into the construction and operational phases. It is noted that a few scenarios were subdivided post-workshop to provide additional definition and clarity, to ensure a more comprehensive Hazard Log. For example, grounding risks during the construction phase (C7) were divided into (a) other (third-party passing) vessels, and (b) the Project works craft.

Table 11.1 List of Hazards

ID	Hazard Title
Construction Phase	
C1	Allision of the Project Works Craft with Port Infrastructure
C2	Allision of Passing Vessel with the Project Marine Works
C3	Collision of Passing Vessel with the Project Works Craft at or near construction site
C4	Collision of the Project Vessel during Navigation within the wider Humber
C5	Collision during Towage Operations
C6	Increased Collision Risk between other vessels due to Displacement away from the Construction Site
C7a	Increased Grounding Risk for Other Vessels due to Displacement from the Project Construction Area
C7b	Grounding Risk for the Project Works Craft
C8	Payload related incidents
Operational Phase	
O1	Collision risk due to Increased Traffic
O2	Collision risk due to Maintenance Dredging
O3a	Collision between Manoeuvring Vessel at the Project and Passing Vessel
O3b	Allision between Passing Vessel and Berthed Vessel at the Project
O4a	Allison of Manoeuvring Vessel with Port Infrastructure
O4b	Allision of Passing Vessel with the Project Infrastructure
O5	Mooring Breakout
O6	Increased Collision Risk between Other Vessels due to Displacement from the Project

O7	Increased Grounding Risk for Other Vessels due to Displacement from the Project

The hazard scenarios identified above have each been considered according to their 'Most Likely' and 'Worst Credible' outcomes. This provides the option to consider very serious outcomes which could credibly occur (i.e., worst credible), together with outcomes that are potentially less serious but could occur on a more frequent basis (i.e., most likely). The full descriptions and evaluations for each hazard scenario are presented within the tabulated Hazard Log in Appendix B of this report.

The assessment of risk is based upon the descriptions of the 'Most Likely' and 'Worst Credible' to determine the outcome in respect of effect to people (human life), property, planet (the environment), and port (business). This approach follows the best practice guidance from the PMSC GtGP (Ref. iv).

11.2 Potential Causes

Potential causes of hazard scenarios identified in Hazard Log are summarised in Table 11.2. Many of the causes apply to more than one hazard, as detailed in the Hazard Log in Appendix B.

Causes were discussed at the workshop and reviewed based on a list of causes extracted from the MarNIS Port Assessment Toolkit used by ABP to carry out marine risk assessments.[5]

Table 11.2 List of Causes within the Project Hazard Log

List of Causes	
1. Human Error	10 Unreported Vessel Defect
2. Fatigue	11. Vessel Breakdown
3. Inadequate Procedures	12. Adverse Weather
4. Inadequate Training	13. Adverse Tides
5. Lack of Awareness	14. Poor Visibility
6. Equipment Failure	15. AtoN Failure
7. Inadequate Towage	16. Failure to Comply with VTS Instructions
8. Berth Mooring System Failure	17. Failure to Comply with Procedures
9. Failure to comply with COLREGS	18. Additional Traffic in River
19. Faulty Radar / AIS	20. Additional Maintenance Dredging
21. Failure to Observe Exclusion Zone	22. Passing Vessel Hydrodynamic Effects

[5] MarNIS contains a more exhaustive list of causes, for example, 'Fatigue' within MarNIS is subdivided into six different personnel categories.

23. Speeding by Passing Vessels	24. Inadequate Moorings
25. Mooring Gear Failure	26. Berth Layout (inc. Exclusion Zone) impinges on existing Traffic Flows
27. Designated Construction Exclusion Zone impinges on existing traffic flows	28. Inadequate surveys

11.3 Risk Controls

Risk controls (mitigations) identified in Hazard Log are summarised in Table 11.2. Many of the controls apply to more than one hazard, as detailed in the Hazard Log in Appendix B.

Controls were discussed at the workshop and reviewed based on a list of controls extracted from the MarNIS Port Assessment Toolkit.[6]

All the risk controls are either embedded, i.e., relate to processes, practices and available safety resources that are in existence prior to the project development, or have been adopted by the Project, such as being incorporated into the design, or planned updates to Port procedures, etc.

11.4 Risk Assessment Results

Table 11.4 presents a summary of the risk rankings for the hazard scenarios contained within the Hazard Log (Appendix B of this report).

The risk rankings are based on the combination of Frequency and Consequences for reach scenario, as per the methodology presented in Section 9.1. The rankings take into account the mitigation measures identified for each hazard which are specified in the Hazard Log, and summarised in Table 11.3.

All the hazards are ranked as either Low ('L') or Medium ('M') risk in terms of both their Most Likely and Worst Credible outcomes.

In general, the most likely outcomes had higher frequency and lower consequences, whereas the Worst Credible outcomes tend to have lower frequency but higher consequences.

[6] MarNIS contains a more exhaustive list of causes, for example, 'Fatigue' within MarNIS is subdivided into six different personnel categories.

Table 11.3 List of Risk Controls

ID	Mitigation Measure and Description
1	Updated port controls, plans and procedures: Existing port documents including the Port Marine Safety Management System (MSMS), Humber Passage Plan (HPP), and Humber Emergency Plan (HEP), will be updated to take into account the Project.
2	Updated Admiralty publications: Information about the Project will be provided to UKHO in a timely manner to allow Charts, Sailing Directions, and Admiralty List of Radio Signal (ALRS), to be updated.
3	Pilotage / PEC: Gas carriers to the Project will be subject to HES pilotage requirements. A significant proportion of vessels passing the Project will also be subject to Pilotage requirements or have Pilotage Exemption Certificate (PEC) holders onboard.
4	Towage: Towage support in terms of the number and power of tugs appropriate to the size of the gas carrier and weather conditions will be provided by tugs from the Sunk Spit Buoy for the passage to the berth, as well as assisting departure. General availability of towage will also help provide assistance in the event of a mooring breakout.
5	VTS: Adherence of vessels to Humber Vessel Traffic Services requirements and instructions. Humber VTS will help control vessel movements and avoid dangerous encounter situations, e.g., involving construction vessels.
6	Aids to Navigation (AtoNs): The marine works shall be appropriately lit as soon as there are items which pose a hazard to navigation. Once operational, aids to navigation shall be provided and maintained so that the structure and berth can be identified. The safe navigation of all vessels in the Humber is aided by numerous existing AtoNs.
7	AIS Equipment: The vast majority of vessels using the Humber broadcast on AIS and therefore can be tracked by other vessels for collision avoidance, as well as by the VTS. The majority of Project vessels, including gas carriers and construction barges, will broadcast on AIS.
8	Passage Planning: Project vessels will have in place appropriate passage plans as well as adhering to the Humber Passage Plan when applicable.

9	Traffic Management: Vessels will be sequenced as per the Humber Passage Plan to help avoid encounters and prevent overtaking, e.g., an IOT vessel will be brought in ahead of a Project vessel to allow both to be berthed at High Water.
10	COLREGS: Vessels will adhere to the Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS).
11	Availability of secondary channel: There is a secondary channel (Foul Holme) that can be used by certain vessels within a set tidal range.
12	Circulation of Information: Information will be circulated about the Project to users of the Humber via Notices to Mariners and river warnings broadcast by the VTS every 2 hrs (or more frequently if required) which consist of maritime safety information, and designated no-go zones. Temporary construction information not on Admiralty charts could be marked by other means, e.g., Portable Pilot Unit (PPU).
13	Stakeholder liaison: Stakeholder engagement and liaison will be held with recreational and fishing representatives to make them aware of the Project and related vessel activities during the different phases.
14	Communications between Project/Port: Discussion of upcoming activities shall take place with the personnel at Immingham, HES and where relevant, the Pilots and IOT.
15	Hydrographic surveys: The current programme of surveying at the Port of Immingham shall be updated to include the Project. The results of the survey shall be provided to the UKHO for use in navigational charts and compared with previous surveys to inform potential requirements for maintenance dredging.
16	Weather limits: The maximum weather limits for operations shall be assessed and set for all activities. These shall be monitored against real time and forecasted weather conditions throughout the construction process. In addition, operational weather limits shall also be considered for vessels using the terminal during the operational phase.
17	Weather monitoring: Weather forecasting and monitoring shall be carried out and compared with the allowable weather limits for reliable planning and assessment of risk regarding the weather operating limits, which will vary between phases and activities, e.g., construction vs. normal operation.
18	Tidal limits: Tidal limits will apply to certain activities (analogous to weather limits).

19	Speed limits: A maximum speed limit of 5 knots will apply to vessels passing the Project berth when a vessel is mooring, moored or unmooring (the same as at IOT).). VTS will monitor for unsafe speeds, including during construction work. Sanctions may be used against repeat offenders, e.g., removal of PEC.
20	Berth design: The Project berth will be aligned with IOT (including the exclusion zone) to maintain the width of the channel to the north (noting most vessels already avoid the planned exclusion zone).
21	Simulations: A real-time ship navigation simulation study has been carried out to demonstrate vessels can navigate safely to/from the Project facility, and that adverse effects are not imposed on other Port users. Further simulations to be carried out, if identified to be necessary, to inform detailed operational requirements.
22	Safety zone: A minimum 150m exclusion zone will apply to passing vessels from the berth line. A suitable construction safety zone will also be designated.
23	Fendering / bollard design: These will be designed to be fit for purpose, and suitable to accommodate range of vessels using berth.
24	Shoreside maintenance program: A regular program of maintenance for infrastructure including mooring bollards/hooks, shall be implemented to ensure that the facility is maintained and fit for use.
25	Mooring study and plans: A mooring study shall be completed for the proposed mooring arrangements at the berth to confirm that there are appropriate moorings available to moor vessels for the operational wind limits and the expected tidal flows.
26	Load monitoring: Monitoring will be in place to detect any ranging of a berthed vessel prior to a potential breakout. Prior consultation with the jetty will be required before a vessel adjusts its mooring.
27	Gas carrier design standards and industry guidance: These vessels have a range of inherent safety features as well as industry guidance which help to prevent or mitigate incidents, such as a potential release.
28	CCTV: CCTV will be used to monitor the jetty area and ensure compliance with procedures.

29	Minimising personnel exposure: Measures to minimise exposure in the event of release of a toxic substance, e.g., ammonia, will be considered, e.g., remote jetty operations and toxic refuges.
30	Emergency plans, exercises and response resources: These will be in place, as appropriate, for each phase. For example, construction contractors shall have tier 1 oil spill response equipment to ensure any pollution events can be contained.
31	Harbours Works Consent: This is consent required before any construction activity can commence. This will follow on from a contractor approval process.
32	Contractor RAMS and SMS: Contractors shall have Risk Assessment Method Statement (RAMS) and Safety Management System (SMS) covering all of the construction activities which shall be reviewed by the Harbour Authority prior to the commencement of activities.
33	CDM Regulations: The Construction (Design and Management) Regulations 2015 will be adhered to, to help protect employee health during construction projects.
34	Standard Operating Procedures (SOP): Suitable procedures will be in place during construction work.
35	Vessel Checks: Checks will be carried out to make sure construction vessels are fit for purpose.
36	Non-Routine Towage (NRT) Assessments: These will be carried out when necessary to assess the risks and establish requirements, e.g., if pilotage is required, number of tugs, radius of towage, tidal restrictions, etc. Covered in HES Towage Guidelines.
37	Designated Point of Contact: During construction activities, there will be a designated PoC to provide appropriate information and respond to emergency situations. This role shall be the main line of communication between the works and the SHA.
38	Safety Vessel: A safety vessel will be ready and on standby during construction activities. The availability of a safety vessel in the area of the marine works shall provide for rapid response to emergency situations and an overview of the activity being conducted; during Construction.
39	Dropped Object Procedure: A dropped object procedure will be in place to report and respond to any drop incidents.

40	Construction Surveys: Pre & post-construction surveys will be carried out to confirm that under keel clearances remain unchanged (in case of unreported incidents).
41	Loading / unloading plan: Equipment and materials being delivered by barge shall have plans specifying the order and method of loading and unloading at the marine works site.

Table 11.4 Risk Rankings for the Project Hazard Scenarios (L = Low; M = Medium)

ID	Hazard Title	Hazard Description	Most Likely Risk				Worst Credible Risk			
			People	Property	Planet	Port	People	Property	Planet	Port
C1	Allision of the Project Works Craft with Port Infrastructure	Works craft manoeuvring in close proximity to port infrastructure, e.g., the Project marine works under construction, or nearby structures such as IOT, makes contact with infrastructure.	M	M	M	M	M	M	M	M
C2	Allision of Passing Vessel with the Project Marine Works	Passing vessel, e.g., tanker on passage to/from the IOT, makes contact with the marine works.	L	M	M	L	M	M	M	M
C3	Collision of Passing Vessel with the Project Works Craft at or near construction site	Passing vessel (commercial, recreational or fishing) manoeuvring around or in proximity to the works in collision with works craft associated with the Project.	M	M	M	M	M	M	M	M
C4	Collision of the Project Vessel during Navigation within the wider Humber	Vessel collision (commercial, recreational or fishing) with works craft, e.g., capital dredger, whilst transiting to/from the Project or during activities within the disposal site (if required), i.e., in the wider River Humber area.	M	M	M	M	M	M	M	M
C5	Collision during Towage Operations	If materials for Project are transported via barges, there is potential for collision with other vessels in the area.	M	M	M	M	M	M	M	M
C6	Increased Collision Risk between other vessels due to Displacement away from the Construction Site	Other (3rd party) vessels using the port have increased vessel-to-vessel collision risk with each other due to displacement caused by the Project.	L	M	M	M	M	M	M	M
C7a	Increased Grounding Risk for Other Vessels due to Displacement from the Project Construction Area	Other (3rd party passing) vessels using the port have increased grounding risk due to displacement away from the Construction Site.	L	L	L	L	M	M	M	M
C7b	Grounding Risk for the Project Works Craft	Works craft grounds during construction work at the Project.	M	M	M	M	M	M	M	M

ID	Hazard Title	Hazard Description	Most Likely Risk				Worst Credible Risk			
			People	Property	Planet	Port	People	Property	Planet	Port
C8	Payload related incidents	If lifting operations are required from barges/vessels associated with the Project, there is potential for incidents to arise from dropped items or affected vessel stability.	L	M	L	L	M	M	M	M
O1	Collision risk due to Increased Traffic	Vessel-to-vessel collision risk increases (over future baseline) due to the additional vessels (e.g., ammonia and CO2 carriers) transiting to/from the Project being involved in a collision with other vessel traffic using the port (e.g., commercial, dredging, recreational or fishing).	M	M	M	M	M	M	M	M
O2	Collision risk due to Maintenance Dredging	Collision risk could potentially be increased (over baseline) due to increased maintenance dredger transit to/from the dredge pocket or during dispersal operations leading to encounters with other marine traffic (commercial, recreational or fishing).	M	M	M	M	M	M	M	M
O3a	Collision between Manoeuvring Vessel at the Project and Passing Vessel	Vessel manoeuvring near the Project berth is involved in a collision with passing vessel (commercial, recreational, or fishing).	L	M	M	M	M	M	M	M
O3b	Allision between Passing Vessel and Berthed Vessel at the Project	Passing vessel (commercial, recreational, or fishing) contacts a vessel berthed at the Project. For example, tanker heading to/from IOT.	L	M	M	M	M	M	M	M
O4a	Allison of Manoeuvring Vessel with Port Infrastructure	Manoeuvring vessel, dredging vessel or tug associated with the Project in contact with port infrastructure, e.g., the Project berth or nearby structures such as IOT, as a result of collision avoidance, adverse weather, nature of the operation or interaction with a passing vessel.	L	M	M	L	M	M	M	M
O4b	Allision of Passing Vessel with the Project Infrastructure	Passing vessel (commercial, recreational, or fishing) contacts the Project infrastructure. For example, tanker heading to/from IOT.	L	M	M	M	M	M	M	M
O5	Mooring Breakout	Vessel breaks away from its moored position.	M	M	M	M	M	M	M	M

ID	Hazard Title	Hazard Description	Most Likely Risk				Worst Credible Risk			
			People	Property	Planet	Port	People	Property	Planet	Port
O6	Increased Collision Risk between Other Vessels due to Displacement from the Project	Other (3rd party) vessels using the port have increased vessel-to-vessel collision risk with each other due to displacement caused by the Project.	L	M	M	M	M	M	M	M
O7	Increased Grounding Risk for Other Vessels due to Displacement from the Project	Other (3rd party) vessels using the port have increased grounding risk due to displacement caused by the Project.	L	L	L	L	M	M	M	M

L = Low; M = Medium

11.5 Tolerability and ALARP

The outcomes of the risk assessment have been considered with respect to ABP's tolerability criteria. These have been established separately for each of the four receptors: People, Property, Planet (environment), and Port (business/reputation). Tolerable regions are identified by the demarcation lines drawn on the risk matrices shown in Figure 11.1, which have been defined for each of the four receptors based on frequency vs. consequence. The frequency and consequence tables, the tolerability limits, the NRA methodology, and the results of the risk assessment were formally approved at a meeting of the ABP Harbour Authority Safety Board (HASB).

Figure 11.1 Tolerability Matrices

By cross-referencing the risk outcomes from Table 11.4 against the tolerability criteria presented in Figure 11.1, it can be seen that all the hazards are assessed to be tolerable based on the risk controls identified in the Hazard Log.

The hazards are also considered to be ALARP given that no additional controls were identified at the HAZID workshop that are not already embedded and/or adopted by the project.

12 Conclusions and Recommendations

The NRA considers potential impacts of the Project to all vessels that operate within the study area including the Port of Immingham. The baseline environment for the shipping and navigation has been described through a desk-based compilation and analysis of datasets including AIS vessel tracking data, historical incident (and near-miss) data, findings from the vessel simulation study, and data collected from the HAZID workshop consultation.

The Hazard Log, based on the discussion at the HAZID workshop, identified a total of 18 unique hazard scenarios associated with the proposed development covering both the construction and operational phases. The hazards were ranked in terms of frequency and consequences to people, property, the planet, and the port. The risks were evaluated based on their most likely and worst credible outcomes. In all cases, the risks were assessed to be tolerable and ALARP based on the mitigation currently in place and/or to be established as part of the project. This includes updates to existing procedures where relevant, such as emergency plans to take into account the risk of ammonia release.

It is recommended that this risk assessment is used to inform amendments to the Marine Safety Management System that is currently in place at the Port of Immingham to ensure that risks are appropriately captured, monitored, and updated as required based on the latest information available as the project progresses.

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Appendix A Hazard Workshop Minutes

Post-Meeting Note: This appendix presents the final minutes from the Hazard Review Workshop held on 10th May 2023, which were approved by all the attendees. It should be noted that there have been some minor modifications to the design since the meeting, but none of these are significant or affect the risk rankings. The alternative option of a set-back berth with larger exclusion zone is no longer being considered by the Project.

A.1 Meeting Overview

Date	10th May 2023		
Time	0900-1430 hrs		
Participants	JB	[redacted]	Anatec
	GF	[redacted]	Anatec
	GJ	[redacted]	ABP Project Design Manager
	JH	[redacted]	ABPmer Maritime
	AM	[redacted]	ABPmer Minute Taker
	VC	[redacted]	Air Products
	MP	[redacted]	HR Wallingford
	OS	[redacted]	APT Oil Terminal
	NK	[redacted]	APT Oil Terminal
	MB	[redacted]	CLdN
	AF	[redacted]	ABP Harbour Master Humber
	IC	[redacted]	ABP HES Senior Pilot
	MC	[redacted]	Dock Master Immingham
	JS	[redacted]	ABP HES Pilot Ops Manager
	JM	[redacted]	ABP HES Pilot
	GB	[redacted]	Svitzer
	SG	[redacted]	SMS Towage
Purpose of Meeting	Navigational Hazard Review Workshop for the Project		

A.2 Agenda

- Welcome and Introductions
- Project Overview
- Simulation Results
- Overview of Baseline & Workshop
- Hazard Review
- Any Other Business (AOB)

A.3 Minutes of Meeting

The key points from the meeting are summarised below under each agenda item.

A.3.1 Introductions

- Introductions were made by all attendees. Apologies for absence from Stephen Rimmer.

A.3.2 Project Overview

- GJ presented an overview of the Project.
- Initial design in PEIR stage had two berths. However, it has been concluded, following a ship fit study, that only one berth is needed for the Project.
- As well as large ammonia carriers, the design will accommodate smaller liquid CO2 vessels (minimum 120m). (*Post-meeting update: Latest estimate is up to 12 ammonia and 280 CO2 / other bulk liquid vessels, giving a maximum of 292 vessel arrivals per year.*)
- Two options are being considered based on the required exclusion zone, which is still under investigation. If a larger exclusion zone is required the berth line will be set back accordingly, so that the effect on passing traffic will be broadly neutral.
- In terms of the timeline for the project, the aim is to submit the DCO application in Aug/Sep 2023. The earliest construction could commence would be winter 2024.

A.3.3 Simulation Results

- MP presented an overview of the navigation simulation exercises carried out at HR Wallingford.
- The simulations were based on the two berths design but were adapted where possible to cover the most challenging manoeuvres for a single berth, considering layout option 1 (aligned with IOT and with 150m exclusion) and layout option 5 (inset with a 250m exclusion zone).
- The simulation runs did not raise any major problems or causes for concern for vessels arriving or departing the Project or IOT. Tests were completed for winds of up 30 knots.
- For passing traffic, it was demonstrated that traffic will be able to pass safely to the north of the Project based on existing protocols. Vessels already avoid IOT based on its 150m exclusion zone, and the impact of vessel displacement due to the Project will be minimal as the Project will be designed to be in-line with IOT (or set back if the larger 250m exclusion zone is required).
- Prior to commencing the hazard review, MP raised the following three points:
  - Towage requirements: These have not been tested for smaller vessels using the Project; this will need further assessment.
  - East of Sunk Spit Buoy: Safety of navigation in this area will need to be considered in due course, once any additional safety requirements for transporting ammonia are known.

- Exclusion / Safety Zones: These have yet to be finalised both for the vessel at berth and when transiting (if applicable) based on ongoing studies.

A.3.4 Baseline Data Review

- JB presented the baseline data being used for the Navigational Risk Assessment (NRA) of the project.
- Twelve months of recent AIS data are being used and have been analysed by vessel type and size. Traffic volumes were relatively stable throughout the year.
- JB noted that AIS does not cover smaller fishing vessels (below 15m in length) and recreational vessels, however, a proportion of these vessel carry it voluntarily, which is encouraged by the port. The numbers not on AIS are estimated by the port to be a small fraction of the vessels broadcasting on AIS.
- The vessel density (heat map) showed the majority of vessels keep to the north of the Project RLB. A proportion of vessels crossed the outer edge of the RLB but this projects out farther north into the river than the planned exclusion zone.
- As well as the main channel, there is a secondary channel (Foul Holme Channel) passing further north of IOT and the Project used by a minority of vessels.
- It was noted that several tanker tracks that currently pass through the Project RLB take a more southerly route (through shallow water, crossing the 5m contour). It was confirmed these are bunker barges, with shallow drafts, which broadcast as tankers on AIS. There are also tankers in deeper water heading to/from IOT which cross the northern part of the Project RLB.
- Based on the AIS review, the impact of passing vessel displacement will be small as the Project will be in-line with IOT, and relatively few vessels currently pass through the planned exclusion zone. Vessels using the IOT (tankers) may need to approach slightly further north if a vessel is berthed at the Project but this is manageable.
- Historical maritime incident data was also reviewed based on 10 years of MarNIS information. (2012-21) This includes both incidents and near-misses.
- AF queried that collisions were stated as one of the main causes of incidents. JB agreed to check after the meeting as it may be imprecise terminology. (*Post-meeting update: Equipment failure and impacts with structure were the most common incident types, not collisions between vessels. This has been updated in the slides*)
- The overall trend in incidents is down although this was not in a straight-line. OS asked if the trend in incidents matched the trend in traffic volumes. JB noted that this can be reviewed to see if there is any correlation.
- AF pointed out a change in reporting incidents in 2017 which caused more pilot ladder defects and weighted heaving lines to be reported as they were a focus area for the port, which explains the peak in incidents in 2017. This change in procedure of reporting incidents is important to note going forward.
- JB asked if data for 2022 would show any significant differences; AF replied it would be a similar pattern.

A.3.5 Overview of Workshop Methodology

- JB outlined the Formal Safety Assessment (FSA) guidelines being used to identify and mitigate against navigational hazards, which is in-line with the Port Marine Safety Code.
- The focus of the meeting is to identify the potential hazards for each phase of the project, discuss the potential causes of the hazards and review mitigation measures (risk controls).
- Following the meeting, the hazards will be assessed in terms of frequency and consequence (expected and worst-credible outcomes) based on the feedback provided at the meeting, as well as the baseline data, and industry experience. The results will be circulated for comment following the meeting.
- The different berth layout options were discussed but it was concluded these would be broadly neutral as the impact on passing traffic would be similar based on the setback of the berth line if a larger exclusion zone is needed. Hence, the hazard review did not need to distinguish between the different layout options but could treat them as one.
- The initial lists of hazards and mitigation measures, based on the Scoping Report and Preliminary Environmental Information Report (PEIR) for the project, were reviewed. (Refer to meeting slides for full list.)
- AF commented that the hazards could be condensed into fewer hazards as many are similar to each other, and the control measures would be the same, unless there is a different risk that arises from a specific vessel type. Construction hazards could also be grouped.
- JB noted the intention was to run through them individually but where it was felt it was identical to a previous hazard this could be noted before moving onto the next hazard. Typically, the first few hazards take the longest to review and then the process speeds up because a lot of the previous discussion also applies.
- JB suggested the operational hazards be reviewed first, as these are the priority based on the 50-year lifespan for the Project. Construction would be reviewed after this noting these will be temporary impacts.
- Future traffic over the 50-year life of the project was discussed. As well as traffic visiting the Project (c. 200 vessels per year inc. up to 12 ammonia), there was also the planned Immingham Eastern Ro-Ro Terminal (IERRT) which is located west of IOT and is planned to have three vessel visits per day. There could be other changes over 50 years.
- AF noted that the port can handle the current traffic volumes and an increase on this, as has been proven in the past when there were higher volumes being handled. Hence, there is existing spare capacity which the Project (and IERRT) will only partly use. There is only an issue if there is additional traffic in excess of what the port can safely handle, which AF indicated will be nowhere near the case. JB stated this will be taken into account when assessing the hazards.

A.3.6 Hazard Review – Operational Phase

A.3.6.1 O1: Collision due to Increased Commercial Vessel Movements

- It was considered whether vessel-to-vessel collision risk would increase (over baseline) due to the additional vessels transiting to/from the Project being involved in a collision with other vessel traffic using the port (e.g., commercial, dredging, recreational or fishing).
- Causes would typically be human error, e.g., watchkeeping failure, distraction, fatigue.
- AF stated that vessels will have two pilots onboard, with rules regarding working hours and rest periods. Various port operational controls are already in place, including the:
  - Humber Passage Plan (HPP)
  - Humber Emergency Plan
  - Port Marine Safety Management System
  - VTS Procedures.
- Vessels are sequenced in their movements according to the HPP. There will be a new chapter in the HPP for the Project.
- It would need to be understood if there was a specific new hazard caused (e.g., due to a different vessel type, i.e., ammonia) and if this hazard causes a significant impact that exceeded the existing controls in place. It was also questioned whether there would be any differences for smaller CO2 vessels versus larger ammonia carriers.
- AF did not anticipate that there will be any significant differences for the Project and therefore no extra controls would be needed. If specific controls were needed, it would be a case of acknowledging the relevant procedures will be reviewed as needed.
- MP noted that the hazards associated with ammonia release over water need to be properly identified and included in this work. The particular dangers associated with inadvertent release of Ammonia over the water present a new and not well understood danger to human life. Until these hazards are properly defined it is not possible to agree on whether additional precautions for navigation around vessels containing the product are appropriate. IC asked if there an industry standard for ammonia release. MP/ GJ stated there is no industry standard. Limited guidance from SIGTTO (Society of International Gas Tanker and Terminal Operators); precautions likely to be similar to LNG /LPG vessels. Can also look into how other ports are dealing with ammonia carriers and adapt for the Humber.
- OS stated the impact of release of ammonia is similar to a release of propane, i.e., they both dissipate quickly.
- GF stated that mitigation for ammonia release would be to review and update the emergency response procedures and safety plan with information from the data sheet, when it exists.
- IC noted the Humber Emergency Plan exists to cover release; an extra chapter will be added to address the specific impact from ammonia release.
- GJ noted the ongoing (separate) study will provide a probability of the event occurring (e.g., <1 in 1 million), from this will form the risk assessment and from this the mitigation will be assessed.

- JB noted a release of cargo could be an outcome from an initiating navigational hazard, e.g., collision, but there are mitigation measures to prevent this, including the design of the vessel to avoid outflow of cargo.
- AF noted that several layers of controls are in place to control vessel movements. AF and IC agreed that ammonia carrier would not need additional controls. MP felt that further work on ammonia is needed before this can be concluded.
- JH indicated the results of the data from the separate ammonia study would trigger a review of the procedures and controls, and would be considered following the outcome of a cost benefit analysis.
- It was discussed what additional mitigation could be applied, such as an escort tug and/or a formal exclusion zone as the vessel moves to the berth. MP noted that other ports handling LNG have an exclusion zone around the vessel. It was again noted that vessels are sequenced, traffic is controlled by Humber VTS, and no overtaking is allowed.
- The list of mitigation measures was reviewed. AF & JB agreed that Vessel Traffic Services (VTS) should be added. AF will review the mitigation list on MarNIS, to check all relevant.
- NK asked if the number of vessels moving in a smaller space had to be considered. AF / IC indicated no as traffic alleviation measures are in place, e.g., there is a second secondary channel (Foul Holme Channel) that can be used within a set tidal range.
- JB asked about collision risk from recreational vessels. AF / IC stated most of these use Class B AIS to increase their visibility but it is optional. They usually participate with VTS requests, but they do not have to. VTS makes regular traffic announcements. There is regular consultation and stakeholder meetings with small vessel users, such as local yacht clubs, so they should be aware of the Project. No extra mitigation for these vessels was considered to be needed.

A.3.6.2 O2: Collision due to Increased Maintenance Dredging Movements

- This hazard is that collision risk could potentially be increased (over baseline) due to increased maintenance dredger transit to/from the dredge pocket or during dispersal operations leading to encounters with other marine traffic (commercial, recreational or fishing).
- AF stated that the risk will be managed by the port as it stays in charge at all times i.e., before, during, and after a maintenance dredge. Dredgers are subject to all the same controls including controls on their movements to avoid obstructing other traffic. Passing vessels will generally have a pilot or PEC onboard.
- NK asked if maintenance dredging is needed after the capital dredge. GJ replied that there is an early indication that there will not be a large need for maintenance dredging after the capital dredge. This will be confirmed after ABPmer have carried out modelling.
- JB asked if any simulation runs had been performed for dredging. MP replied that dredging was not considered in the simulations.

- JB asked about the locations of disposal sites. AF replied these will either be to the east or west of the RLB.

A.3.6.3 O3: Collision at Berth with Passing Traffic

- This hazard is that a vessel manoeuvring at the Project berth is involved in a collision with a passing vessel (commercial, recreational, or fishing).
- AF suggested this hazard was very similar to Hazard O1. IC agreed, no extra vulnerability as controls are already in place (pilotage, secondary channel if heading further up river, exclusion zone, speed limits when passing, vessels on AIS).
- The planned exclusion zone will provide a safety buffer. MP noted the exclusion zone may need to be increased compared to IOT due to the nature of the ammonia cargo. If that is the case, the berth line will be set back. Communication will also take place between the Project and IOT.
- JH noted that work is ongoing, therefore need to capture that there is a procedure in place to review the protocol within the HES Marine Safety Management System. This procedure will need to be reviewed once there is data on the risk from ammonia.
- JB noted that Tugs will be broadcasting on AIS. The consequence of any collision will be limited by the processes in place.

A.3.6.4 O4: Contact with Mooring Infrastructure

- Maneuvering vessel, dredging vessel or tug in contact with the jetty as a result of collision avoidance, adverse weather, nature of the operation or interaction with a passing vessel.
- MP noted that during simulations operations were generally completed at slack low or high water. Further simulations (or other form of assessment) would be required to assess the safety of operations at other states of flow. Passing vessels hazards were also discussed. Recreational and fishing vessels will tend to keep well clear of the berth. If the Project berth is empty a tanker to IOT could pass through the exclusion zone, but very low likelihood of contacting the Project. It would be similar to a vessel to IOT2 contacting IOT1. Similarly, for an IOT tug moving past the berth, there is very low likelihood of contact, as evidenced by historical data.
- In terms of mitigation, the importance of the berth having suitably designed and engineered fendering and bollards was highlighted. AF stated this needs to be fit for purpose to accommodate the range of vessels (CO2 and ammonia) that will be using the berth. GJ agreed that industry design standards would be adhered to.

A.3.6.5 O5: Mooring Breakout with Vessel Alongside

- Potential for a vessel to break its moorings and to leave the berth due to stress of weather, passing vessels or mooring equipment failure.
- AF stated there has never been a known breakout at IOT. This is due to the management in place, not the fact that there is zero risk of it occurring, e.g., speed limits and load alarms on mooring hooks.

- VTS monitor vessel speeds, with byelaws in place to impose limits. If a vessel master is identified as a repeat offender, then PEC could be removed from them.
- GJ asked if there was data of vessels exceeding their speed limit. AF replied that it exists and is recorded at near miss stage. There is a license in place for pilots to follow.
- MC noted to have moorings able to cope with extra stress/tightening. GJ stated that a mooring analysis and plan will be carried out.
- NK has seen examples of quick release hooks being used where no one is required to be on the jetty, allowing remote operation in case of toxic cargoes. Can also have toxic refuges.
- IC noted terminal requirement that ships cannot adjust their mooring without prior consultation with the jetty.
- Mitigation was noted by AF as fenders being at the right size and in the right position (including height).
- MP noted that the mooring conditions would be sensitive to vessel size and that it might be worth considering direction of bow during any study.

A.3.6.6 O6: Increased Collision Risk between Other Vessels

- This hazard is that other vessels using the port (not associated with the Project) have increased vessel-to-vessel collision risk with each other due to displacement caused by the Project.
- From the review of the baseline AIS data, the effect of the exclusion zone will be limited as the Project berth will be aligned with IOT (or set back), which the majority of passing traffic is already avoiding.
- MP stated that the simulations had looked into displacement issues for vessels to/from IOT. These vessels will be displaced to the north of the Project but pilots assessed that there was sufficient space, noting activities will take place at slack water, and will be well managed.
- Abort and emergency procedures were also tested via simulation. The Project will reduce the safe water available to abort an approach to IOT but it was still generated to be safe.
- OS expressed potential concern about loss of time slots. This was recognised to be a commercial issue, not navigational safety, so not relevant to the workshop. It was noted that due to the sailing arrangement for inbound vessels, IOT vessel would be ahead of the Project, so delays would be to the Project vessel. However, smaller CO2 vessels could come in at different tides.
- AF confirmed that certain vessels (< 9,000 tonnes) are not tidally impacted. When considering movements need to consider tidal impact. This needs capturing and further research to establish this for the Project. Not key to navigational safety but worth capturing. GJ stated that a procedure will need to be developed based on the size of CO2 carriers.
- MP noted that at the simulations it had been demonstrated that passing vessels north of IOT and the Project were not additionally constrained by the presence of the Project and any associated exclusion zone - so long as the extent of the exclusion zone lay

behind the existing 150m line parallel and north of IOT. HR Wallingford consider that large vessels should avoid passing each other in the area of the channel immediately north of the IOT, based on existing situation.

A.3.6.7 O7: Increased Grounding Risk for Other Vessels

- This hazard is that other vessels using the port experience higher grounding risk due to displacement caused by the Project.
- As discussed for O6, there will be limited displacement due to the Project being aligned with IOT. This was confirmed by the simulations which showed no constraints.
- The risk of vessels being displaced to such an extent that it causes an increased risk of grounding was considered to be minimal.
- No further mitigation was considered necessary.

A.3.7 Hazard Review – Construction Phase

- It was generally noted that a Harbour Works Consent will be required for construction. This is a key barrier for construction hazards as the work cannot start until this is in place. Construction would be governed by the requirements of the Construction Design and Management (CDM) Regulations 2015.

A.3.7.1 C1: Contact of Works Craft with Port Infrastructure

- Manoeuvring of works craft in close proximity to marine structures has the potential for contact with infrastructure during site development.
- The primary cause is likely to be human error.
- AF noted there have been several developments in the area. Based on this experience there is a need for segregation, i.e., demarcating working areas from non-working areas where it is business as usual.
- This can be done by using temporary buoys (though probably not needed in this case as they can cause entanglement issues), Notices to Mariners, regular river broadcasts, speed controls, local stakeholder liaison, Construction Risk Assessment Method Statements (RAMS), Contractor Safety Management System (SMS), checks to make sure vessels involved are fit for purpose, contractor approval process, CDM, tidal restrictions, weather limits, Standard Operating Procedures (SOP), non-routine towage assessments, etc.
- AF stated the port would review vessels and plans before issuing a Harbour Works Consent. No work could be carried out without this. It would not be issued to contractors until the appropriate checks had been carried out.
- OS asked if construction would be from outwards in or vice versa. This is to be confirmed. Also noted that in a flood tide, vessels could potentially come closer to structures as there will be available water.
- Safety boat may be able to help out depending on the scenario.

A.3.7.2 C2: Contact of Passing Vessel with Marine Works

- Passing vessels, such as tankers on passage to/from the IOT, have the potential to make contact with the marine works.
- AF stated mitigations of Notice to Mariners, river warnings broadcast by the VTS every 2hrs (or more frequently if required) which consists of maritime safety information, and designated no-go zones.
- Consideration will be given to marking the work area on charts but as its temporary it may not be necessary. However, VTS and pilots, etc., could plot it on their electronic displays.
- IC noted that if the VTS observed a third-party vessel approaching the works or travelling at unsafe speed they can remind them that works are in place. However, the majority of the work site will be south of the main channel.
- Stakeholder engagement and liaison will be held including with recreational and fishing representatives to make them aware of the activity.
- A safety boat will also be present but its role is to look after the site rather than acting as a guard vessel.

A.3.7.3 C3: Collision of Passing Vessels with Works Craft

- As passing vessels (commercial, recreational or fishing) are manoeuvring around or in proximity to the works there is the potential for collision with craft associated with the Project.
- AF stated that works craft will need to report to the VTS before leaving the construction area. Permission will not be granted if there is a risk of collision / obstruction to a passing vessel.
- Once outside of the construction area, vessels will be subject to the existing maritime rules. No additional concern over what already exists.
- NK asked if the plan was to build outward from the land or inward from the sea, or meet in the middle. This would be useful to know as may influence the mitigation required. GJ had left the meeting at this point but JB will follow-up to find out the answer. It was noted that the priority is always to reduce the time of construction in a given area. (*Post-meeting update: GJ confirmed that both options for construction remain open to the contractor.*)

A.3.7.4 C4: Collision during Navigation

- This hazard relates to a potential vessel collision (commercial, recreational or fishing) with works craft whilst transiting to/from the Project or during activities within the disposal site (if required), i.e., in the wider River Humber area.
- Pre-works meeting will be held to ensure approved personnel have appropriate qualifications and knowledge and are familiar with the area before they start working.
- Pilotage and/or training can be imposed on works craft if needed. Vessels may be boarded to carry out checks and inspections.
- As per C3, works vessels will need to obtain permission from the VTS before leaving the construction area. Once outside of the construction area, vessels will be subject to the general maritime rules and safeguards.

- JB asked if there were any significant lessons learned from previous construction projects, but not the case as these have been executed safely. Key consideration is the location of the Project, but unlikely to have significant impacts.

A.3.7.5 C5: Collision during Towage Operations

- If materials for Project are transported via barges, there is potential for collision with other vessels in the area.
- Non-routine towage (NRT) assessments would assess the risks and would establish if, e.g., need pilotage, how many tugs are needed, the radius of towage, tidal restrictions. Covered in HES Towage Guidelines.
- IC noted that all items will need to be reviewed in NRT assessment before authorisation is given. Would need to understand if Immingham port's own tugs are to be used, or if tugs are going to be provided by the Project. Depending on if the tugs are owned or rented, different risks may arise, and mitigations may apply.

A.3.7.6 C6: Increased Collision Risk between Other Vessels

- This hazard considers the potential for increased collision risk between other (third-party) vessels due to displacement away from the construction site (including any marshalling area).
- The hazard will vary depending on the start point of the work. Ideally want to minimise the time spent in the area used by vessels to minimise the collision risk, i.e., less concern around the shore but more risk when stepping out into the channel. This could be minimised by starting from the shore and working outwards in which case the risk mainly come towards the end of the project.
- Risk can be minimised by designing a suitable designated area.
- JB asked if Trinity House would be consulted on any aids to navigation. AF replied that Trinity House would be informed if putting in buoys / markers, but may not be needed, and they have potential entanglement issues.
- Virtual AIS markers have been used by the port if a buoy is temporarily lost, but unlikely to be used to mark the construction site.
- Could mark the area on Admiralty Charts but of limited benefit. Those who need to know, such as Pilots and PECS, can be informed by other means previously discussed and could mark the area, e.g., on Portable Pilot Unit (PPU).

A.3.7.7 C7: Increased Grounding Risk for Other Vessels

- This hazard considers the potential for increased grounding risk to other (third-party) vessels due to displacement away from the construction site (including any marshalling area).
- It was considered that there would be minimal risk to other vessels provided standard measures were taken, as outlined for the other construction hazards.
- AF noted that grounding does have to be considered as a risk to construction vessels. Mitigation exists including Contractor SMS, passage plans, and weather and tidal limits. There will be some work only carried out in certain tides.

- During this period there will be more intensive dredging over a shorter period. Subject to pilotage / PEC and other controls discussed earlier. Similar disposal area as per operation (likely to be to the NE).

A.3.7.8 C8: Payload related Incidents

- If lifting operations are required from barges/vessels associated with the Project, there is potential for incidents to arise from dropped items or affected vessel stability.
- AF noted there would be a survey pre-construction and afterwards would do a check to ensure nothing is left on the surface or has been dropped. To make sure nothing is on the seabed that could affect the chart datum on Admiralty charts.
- IC added that speed restrictions when passing the construction area would reduce the risk of vessel instability.

A.4 AoB

- AF noted a lot of mitigations exists in practice but are not covered in the summary list presented. These need to be fleshed out more to capture all mitigation that is in place, or a more general comment could be made that supporting procedures would also apply.
- Additional mitigation measures were reviewed that had been output by the Harbour Master from MarNIS. Relevant measures were checked. Anatec will also review the IERRT work as many of the mitigations will apply to the Project.
- It was noted that APT should be kept informed throughout the Project.
- AIS on construction vessels was discussed. This was encouraged by the port as nice-to-have, but not seen as essential as some smaller vessels will be below the carriage requirements.
- AF reiterated that the harbour consent procedure is a key barrier and is the last check before MMO sign off the project and works can start.

A.5 Next Steps

- Minutes will be circulated for review and comment.
- Anatec will use the methodology (issued by GJ in advance of the meeting) to rank the hazards. JB confirmed there were no comments or questions on the methodology.
- The results of the hazard rankings will be circulated to attendees for comment. JB asked if anyone felt that any of the hazards discussed would be intolerable or unacceptable based on the mitigation measures to be applied. No one indicated this to be the case.
- MB stated it was of high importance to him to understand the berth size, as he is unable to sign off consent if the design is not well understood.
- MP noted that there would be no need for further simulations to support NRA assuming that the berth design falls within the limits of an envelope defined by the positions of berths used in the simulations (layout 1b and 5). Future operations will

need some form of further assessment to define detailed procedures; simulation would be an effective way to achieve this.

- OS stated that it is important to define ALARP in the risk assessment as there can be different interpretation of ALARP for different risks.

Appendix B Hazard Log

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
							Consequences				Risk						Consequences				Risk				
						Frequency	People	Property	Planet	Business	People	Property	Planet	Port		Frequency	People	Property	Planet	Business	People	Property	Planet	Port	
C1	Allision of the Project Works Craft with Port Infrastructure	Works craft manoeuvring in close proximity to port infrastructure, e.g., the Project marine works under construction, or nearby structures such as IOT, makes contact with infrastructure.	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Bad weather, e.g., strong winds or poor visibility Strong tidal flows Inadequate procedures Failure to comply with procedures Equipment failure on vessel	Harbours Works Consent required before activity starts Contractor SMS and RAMS Vessel checks Contractor approval process Standard Operating Procedures (SOP) CDM Regulations Non-Routine Towage Assessments Demarcation of working areas Safety vessel Weather limits Tidal limits Communications with Port VTS Emergency plans, exercises and response resources Aids to Navigation	Minor (low-speed) impact with jetty resulting in limited damage, and possibility of slight injury and/or minor spill	4	2	2	2	2	Medium	Medium	Medium	Medium	Higher speed impact resulting in severe damage to vessel / jetty, causing pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	A Harbour Works Consent will be required for construction. This is a key barrier for construction hazards as the work cannot start until this is in place. Construction would be governed by the requirements of the Construction Design and Management (CDM) Regulations 2015.
C2	Allision of Passing Vessel with the Project Marine Works	Passing vessel, e.g., tanker on passage to/from the IOT, makes contact with the marine works.	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to observe designated exclusion zone around construction site Failure to comply with COLREGS Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures	Designated exclusion zone during construction Aids to Navigation Notices to Mariners River warnings broadcast by the VTS every 2 hrs (or more frequently if required) Pilotage / PEC on passing vessels (where applicable) Passage planning VTS (including monitoring of any vessels approaching the zone and their speeds) Safety vessel Allowable weather limits, e.g., restrictions in fog Adherence to COLREGS Majority of work site will be to south of main channel Availability of secondary channel (Foul Holme) used by some vessels in certain tides Regular stakeholder liaison including small vessel users Emergency plans, exercises and response resources	Minor impact with marine works resulting in limited damage to vessel / works, and possibility of slight injury and/or minor spill. Inspections and minor repairs required leading to delay	3	1	2	2	1	Low	Medium	Medium	Low	Higher speed impact resulting in severe damage to vessel and/or marine works causing pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
							Consequences				Risk						Consequences				Risk				
						Frequency	People	Property	Planet	Business	People	Property	Planet	Port		Frequency	People	Property	Planet	Business	People	Property	Planet	Port	
C3	Collision of Passing Vessel with the Project Works Craft	Passing vessel (commercial, recreational or fishing) manoeuvring around or in proximity to the works in collision with works craft associated with the Project	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to observe designated exclusion zone around construction site Failure to comply with COLREGS Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures	Designated exclusion zone during construction Authorisation required from VTS prior to leaving the construction area Aids to Navigation Notices to Mariners River warnings broadcast by VTS every 2hrs (or more frequently if required) Pilotage / PEC on passing vessels (where applicable) Passage planning VTS Safety vessel Allowable weather limits, e.g., restrictions in fog Tidal limits Adherence to COLREGS Majority of work site will be to south of main channel Availability of secondary channel (Foul Holme) used by some vessels in certain tides Regular stakeholder liaison including small vessel users Vessel checks Standard Operating Procedures (SOP) CDM Regulations Non-Routine Towage Assessments Communications with port and nearby users Emergency plans, exercises and response resources	Minor impact with works craft resulting in limited damage to vessels, and possibility of slight injury and/or minor spill	3	2	2	2	2	Medium	Medium	Medium	Medium	Higher-speed collision between vessels resulting in severe damage, causing pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	
C4	Collision of the Project Vessel during Navigation	Vessel collision (commercial, recreational or fishing) with works craft, e.g., capital dredger, whilst transiting to/from the Project or during activities within the disposal site (if required), i.e., in the wider River Humber area.	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunicationFaulty Radar / AIS Poor visibilityFailure to comply with COLREGSFailure to comply with VTS instructionsInadequate proceduresFailure to comply with procedures	Pre-works meetings and approvals from Port Authorisation required from VTS prior to leaving the construction area Vessel checks Pilotage and/or training can be imposed on works craft (if required) Passage planning VTS AIS Allowable weather limits, e.g., restrictions in fog Adherence to COLREGS	Collision between works vessel and 3rd party vessel resulting in limited damage to one or both, and possibility of slight injury and/or minor spill	3	2	2	2	2	Medium	Medium	Medium	Medium	Collision between works vessel and 3rd party vessel resulting in severe damage, causing pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
							Consequences				Risk						Consequences				Risk				
						Frequency	People	Property	Planet	Business	People	Property	Planet	Port		Frequency	People	Property	Planet	Business	People	Property	Planet	Port	
				Adherence to VTS requirements Regular stakeholder liaison including small vessel users Emergency plans, exercises and response resources																					
C5	Collision during Towage Operations	If materials for Project are transported via barges, there is potential for collision with other vessels in the area	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to comply with COLREGS Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures Inadequate towage Equipment failure	HES Towage Guidelines Non-routine towage assessment Pilotage (if required) Appropriate number and power of tugs Tidal limits Weather limits Authorisation required from VTS prior to leaving the construction area Vessel checks Passage planning AIS Adherence to COLREGS Adherence to VTS requirements Notices to Mariners River warnings broadcast by the VTS every 2 hrs (or more frequently if required) Regular stakeholder liaison including small vessel users Emergency plans, exercises and response resources	Collision between works vessel (tug and/or barge) and 3rd party vessel resulting in limited damage, and possibility of slight injury and/or minor spill	3	2	2	2	2	Medium	Medium	Medium	Medium	Collision between works vessel (tug and/or barge) and 3rd party vessel resulting in severe damage causing pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	
C6	Increased Collision Risk between other vessels due to Displacement away from the Construction Site	Other (3rd party) vessels using the port have increased vessel-to-vessel collision risk with each other due to displacement caused by the Project	Designated construction exclusion zone impinges on existing traffic flows Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to comply with COLREGS Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures	Design of suitable designated area River warnings broadcast by the VTS every 2 hrs (or more frequently if required) Aids to Navigation Most vessels already avoid the area Pilotage / PEC (where applicable) Marking area on Portable Pilot Unit (PPU) Passage planning VTS AIS Sequencing of vessel movements according to Humber Passage Plan Existing port controls, plans and procedures Adherence to COLREGS	Limited displacement due to reduced sea room causing closer encounters with potential for minor collision between two vessels, and possibility of slight injury and/or minor spill	3	1	2	2	2	Low	Medium	Medium	Medium	Reduced sea room leads to a major collision incident between two passing vessels with resulting severe damage, causing pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	Hazard will depend on start point, with work closer to shore having less of an impact than further out into the channel Trinity House will be informed if putting in buoys / markers, but may not be needed, and they have potential entanglement issues. Marking on Admiralty Charts and use of Virtual AtoNs considered to be of limited benefit

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
							Consequences				Risk						Consequences				Risk				
						Frequency	People	Property	Planet	Business	People	Property	Planet	Port		Frequency	People	Property	Planet	Business	People	Property	Planet	Port	
				Availability of secondary channel (Foul Holme) used by some vessels in certain tides Notices to Mariners Regular stakeholder liaison including small vessel users Emergency plans, exercises and response resources																					
C7a	Increased Grounding Risk for Other Vessels due to Displacement from the Project Construction Area	Other (3rd party passing) vessels using the port have increased grounding risk due to displacement away from the Construction Site	Designated construction exclusion zone impinges on existing traffic flows Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures	Design of suitable designated area Most vessels already avoid the area River warnings broadcast by the VTS every 2 hrs (or more frequently if required) Aids to Navigation Hydrographic Surveys Pilotage / PEC (where applicable) Passage planning VTS AIS Existing port controls, plans and procedures Availability of secondary channel (Foul Holme) used by some vessels in certain tides Notices to Mariners Regular stakeholder liaison including small vessel users Emergency plans, exercises and response resources	Limited displacement due to reduced sea room causing a proportion of vessels to pass marginally closer to shallow water or to have reduced under keel clearance during part of transit	2	2	2	2	2	Low	Low	Low	Low	Vessel displaced to a greater extent, possibly following an encounter, leading to grounding, resulting in severe damage, pollution and loss of life.	1	5	5	5	5	Medium	Medium	Medium	Medium	Hazard will depend on start point, with work closer to shore having less of an impact than further out into the channel. Trinity House will be informed if putting in buoys / markers, but may not be needed, and they have potential entanglement issues. Marking on Admiralty Charts and use of Virtual AtoNs considered to be of limited benefit.
C7b	Grounding Risk for the Project Works Craft	Works craft grounds during construction work at the Project	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunicationFaulty Radar / AIS Poor visibilityInadequate proceduresFailure to comply with proceduresInadequate surveys	Demarcation of working areas Aids to Navigation Hydrographic Surveys Passage planning VTS Existing port controls, plans and procedures Emergency plans, exercises and response resources Contractor SMS and RAMS Contractor approval process Standard Operating Procedures (SOP) CDM Regulations Safety vessel Weather limits	Work vessel hull touches bottom or underwater infrastructure associated with project causing limited damage and possibility of slight injury and/or minor spill	3	2	2	2	2	Medium	Medium	Medium	Medium	Work vessel grounds resulting in severe damage, pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
							Consequences				Risk						Consequences				Risk				
						Frequency	People	Property	Planet	Business	People	Property	Planet	Port		Frequency	People	Property	Planet	Business	People	Property	Planet	Port	
				Tidal limits Communications with Port																					
C8	Payload related incidents	If lifting operations are required from barges/vessels associated with the Project, there is potential for incidents to arise from dropped items or affected vessel stability	Human error, e.g., distraction, fatigue, misjudgement, miscommunication Inadequate procedures Failure to comply with procedures Equipment failure Passing vessel at inappropriate speed	Dropped object procedure, Loading / unloading plan, Pre & post-construction surveys to confirm chart datum unchanged Speed restrictions on passing vessels VTS Weather limits Tidal limits SOPs Contractor SMS and RAMs Contractor approval process CDM Regulations Safety vessel Communications with Port Emergency plans, exercises and response resources	Dropped object which is reported and recovered (if appropriate)	4	1	2	1	1	Low	Medium	Low	Low	Unreported dropped object causing temporary under water hazard, e.g., reducing under keel clearance below CD, until detected during survey. Transiting vessel interacts with underwater hazard resulting in severe damage, pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
							Consequences				Risk						Consequences				Risk				
						Frequency	People	Property	Planet	Business	People	Property	Planet	Port		Frequency	People	Property	Planet	Business	People	Property	Planet	Port	
O1	Collision risk due to Increased Traffic	Vessel-to-vessel collision risk increases (over baseline) due to the additional vessels (e.g., ammonia and CO2 carriers) transiting to/from the Project being involved in a collision with other vessel traffic using the port (e.g., commercial, dredging, recreational or fishing).	Additional the Project traffic in river Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to comply with COLREGS Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures	Pilotage (the Project vessels and other vessels, where applicable) Passage planning VTS AIS Existing port controls, plans and procedures, to be reviewed and updated to include the Project, e.g., Port MSMS, Humber Passage Plan & Humber Emergency Plan Sequencing of vessel movements according to Humber Passage Plan Allowable weather limits, e.g., restrictions in fog Adherence to COLREGS Adherence to VTS requirements Availability of secondary channel (Foul Holme) used by some vessels in certain tides Regular stakeholder liaison including small vessel users Gas carrier design standards and industry guidance	Collision between Project vessel and 3rd party vessel resulting in limited damage to one or both, and possibility of slight injury and/or minor spill	3	2	2	2	2	Medium	Medium	Medium	Medium	Collision between a project vessel and a 3rd party vessel resulting in more serious damage. Worst-case outcome of ammonia release and loss of life.	1	5	5	5	5	Medium	Medium	Medium	Medium	Number of movements associated with the Project is relatively low compared with current traffic using the port, and only a fraction of these (up to 12 per year) will be ammonia carrier. Port has existing spare capacity and has handled higher volumes in the past. Ongoing work looking at risk of ammonia release. Additional potential mitigation of formal exclusion zone around ammonia vessel when in transit and escort tug were not considered necessary.
O2	Collision risk due to Maintenance Dredging	Collision risk could potentially be increased (over baseline) due to increased maintenance dredger transit to/from the dredge pocket or during dispersal operations leading to encounters with other marine traffic (commercial, recreational or fishing).	Additional maintenance dredging Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to comply with COLREGS Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures	Control of dredger movements to avoid obstructing other port traffic Pilot / PEC on other vessels (where applicable) Passage planning VTS AIS Existing port controls, plans and procedures Allowable weather limits, e.g., restrictions in fog Adherence to COLREGS Notice to mariners Regular stakeholder liaison including small vessel users	Collision between maintenance dredger vessel and 3rd party vessel resulting in limited damage to one or both, and possibility of slight injury and/or minor spill	3	2	2	2	2	Medium	Medium	Medium	Medium	Collision between a maintenance dredger and a 3rd party vessel resulting in more serious damage. Worst-case outcome of spill and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	Extent of maintenance dredging not expected to be large (other work being carried out to confirm)

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
						Frequency	Consequences				Risk					Frequency	Consequences				Risk				
							People	Property	Planet	Business	People	Property	Planet	Port			People	Property	Planet	Business	People	Property	Planet	Port	
O3a	Collision between Manoeuvring Vessel at the Project and Passing Vessel	Vessel manoeuvring near the Project berth is involved in a collision with passing vessel (commercial, recreational, or fishing).	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to observe exclusion zone Failure to comply with COLREGS Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures Lack of awareness	Exclusion zone (minimum 150m) The Project berth will be aligned with IOT; if larger exclusion zone is required, berth line will be set back Speed limit when passing berth - maximum 5 knots Pilotage / PEC on passing vessels (where applicable) Passage planning VTS AIS (including tugs) Existing port controls, plans and procedures, to be reviewed and updated to include the Project, e.g., Port MSMS, Humber Passage Plan & Humber Emergency Plan Sequencing of vessel movements according to Humber Passage Plan Updated Humber Emergency Plan (including ammonia risk) Allowable weather limits, e.g., restrictions in fog Adherence to COLREGS Aids to Navigation Admiralty Charts - updated to include the Project Availability of secondary channel (Foul Holme) used by some vessels in certain tides Communications between the Project and IOT Gas carrier design standards and industry guidance	Collision between project vessel near berth and 3rd party vessel resulting in limited damage to one or both vessels, and possibility of slight injury and/or minor spill	3	1	2	2	2	Low	Medium	Medium	Medium	Collision between project vessel near berth and a passing vessel resulting in severe damage, ammonia release and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	Berth layout option to be finalised. Exclusion zone of 150m has been assumed (aligned with IOT). If berth is setback due to larger exclusion zone, this hazard is reduced.

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
						Frequency	Consequences				Risk					Frequency	Consequences				Risk				
							People	Property	Planet	Business	People	Property	Planet	Port			People	Property	Planet	Business	People	Property	Planet	Port	
O3b	Allision between Passing Vessel and Berthed Vessel at the Project	Passing vessel (commercial, recreational, or fishing) contacts a vessel berthed at the Project. For example, tanker heading to/from IOT.	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to observe exclusion zone Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures Lack of awareness	Exclusion zone (minimum 150m) The Project berth will be aligned with IOT; if larger exclusion zone is required, berth line will be set back Speed limit when passing berth - maximum 5 knots Pilotage / PEC on passing vessels (where applicable) Passage planning VTS AIS Existing port controls, plans and procedures, to be reviewed and updated to include the Project, e.g., Port MSMS, Humber Passage Plan & Humber Emergency Plan Sequencing of vessel movements according to Humber Passage Plan Updated Humber Emergency Plan (including ammonia risk) Allowable weather limits, e.g., restrictions in fog Adherence to COLREGS Aids to Navigation Admiralty Charts - updated to include the Project Availability of secondary channel (Foul Holme) used by some vessels in certain tides Communications between the Project and IOT Gas carrier design standards and industry guidance	Glancing impact between passing vessel and berthed vessel resulting in limited damage to one or both vessels, and possibility of slight injury and/or minor spill	3	1	2	2	2	Low	Medium	Medium	Medium	Higher energy impact resulting in severe damage, ammonia release, oil spill and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	Berth layout option to be finalised. Exclusion zone of 150m has been assumed (aligned with IOT). If berth is setback due to larger exclusion zone, this hazard is reduced.

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
						Frequency	Consequences				Risk					Frequency	Consequences				Risk				
							People	Property	Planet	Business	People	Property	Planet	Port			People	Property	Planet	Business	People	Property	Planet	Port	
O4a	Allison of Manoeuvring Vessel with Port Infrastructure	Manoeuvring vessel, dredging vessel or tug associated with the Project in contact with port infrastructure, e.g., the Project berth or nearby structures such as IOT, as a result of collision avoidance, adverse weather, nature of the operation or interaction with a passing vessel.	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Bad weather, e.g., strong winds or poor visibility Strong tidal flows Lack of awareness Inadequate towage Inadequate procedures Failure to comply with procedures Equipment failure on vessel	Simulations (demonstrated operations can be carried out safely in different tides / weather) Towage Pilotage / PEC Weather limits Tidal limits - approaches will only be undertaken at HW slack Aids to Navigation Admiralty Charts - updated to include the Project Communications with Port and IOT (e.g., concurrent operations) VTS Sequencing of vessel movements Exclusion zone provides a buffer to passing traffic Fendering / bollards designed to be fit for purpose and suitable to accommodate range of vessels using berth Existing port controls, plans and procedures, to be reviewed and updated to include the Project, e.g., Port MSMS, Humber Passage Plan & Humber Emergency Plan Gas carrier design standards and industry guidance	Minor (low-speed) impact resulting in limited damage to fender and/or vessel, and possibility of slight injury and/or minor spill	4	1	2	2	1	Low	Medium	Medium	Low	Higher speed impact resulting in severe damage to vessel / structure, ammonia release and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
							Consequences				Risk						Consequences				Risk				
						Frequency	People	Property	Planet	Business	People	Property	Planet	Port		Frequency	People	Property	Planet	Business	People	Property	Planet	Port	
O4b	Allision of Passing Vessel with the Project Infrastructure	Passing vessel (commercial, recreational, or fishing) contacts the Project infrastructure. For example, tanker heading to/from IOT.	Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to observe exclusion zone Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures Lack of awareness	The Project berth will be aligned with IOT; if larger exclusion zone is required, berth line will be set back Pilotage / PEC on passing vessels (where applicable) Passage planning VTS AIS Existing port controls, plans and procedures, to be reviewed and updated to include the Project, e.g., Port MSMS, Humber Passage Plan & Humber Emergency Plan Sequencing of vessel movements according to Humber Passage Plan Allowable weather limits, e.g., restrictions in fog Adherence to COLREGS Aids to Navigation Admiralty Charts - updated to include the Project Availability of secondary channel (Foul Holme) used by some vessels in certain tides Communications between the Project and IOT	Glancing impact between passing vessel and the Project resulting in limited damage, and possibility of slight injury and/or minor spill	3	1	2	2	2	Low	Medium	Medium	Medium	Higher energy impact resulting in severe damage, oil spill and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	Berth layout option to be finalised. Exclusion zone of 150m has been assumed (aligned with IOT). If berth is setback due to larger exclusion zone, this hazard is reduced.
O5	Mooring Breakout	Vessel breaks away from its moored position.	Strong winds Passing vessel hydrodynamic effects Lack of awareness Speeding by passing vessels Inadequate moorings Mooring gear failure	Mooring analysis study Mooring plan Weather limits Speed limits for passing vessels - max 5 knots Exclusion zone provides a buffer to passing traffic Fendering / bollards designed to be fit for purpose Prior consultation with jetty required before ship adjusts mooring Load monitoring CCTV Remote jetty operations to reduce exposure to toxic cargoes Refuges in case of toxic release Existing port controls, plans	Vessel ranges from berth but is re-secured with or without tug assistance. Potential for minor contact with berth / fender, and delay in discharge time.	4	1	2	2	2	Low	Medium	Medium	Medium	Vessel completely breaks mooring with risk of heavy contact with jetty, and/or drifting into channel with risk of escalation, e.g., collision, contact or grounding. Severe damage causing ammonia release and loss of life if breakout occurs during cargo	2	5	5	5	5	Medium	Medium	Medium	Medium	Sensitivity assessment on the range of vessel sizes and direction of bow suggested at workshop

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
							Consequences				Risk						Consequences				Risk				
						Frequency	People	Property	Planet	Business	People	Property	Planet	Port		Frequency	People	Property	Planet	Business	People	Property	Planet	Port	
				and procedures, to be reviewed and updated to include the Project, e.g., Port MSMS, Humber Passage Plan & Humber Emergency Plan Gas carrier design standards and industry guidance Tug availability											transfer, and/or event escalates.										
O6	Increased Collision Risk between Other Vessels due to Displacement from the Project	Other (3rd party) vessels using the port have increased vessel-to-vessel collision risk with each other due to displacement caused by the Project	Berth layout inc. exclusion zone impinges on existing traffic flows Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to comply with COLREGS Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures	Berth aligned with IOT (including set back if larger exclusion zone required) Most vessels already avoid the planned exclusion zone Pilotage / PEC (where applicable) Simulations demonstrated sufficient space for IOT vessels displaced to north Passage planning VTS AIS Aids to Navigation Admiralty Charts - updated to include the Project Existing port controls, plans and procedures Sequencing of vessel movements according to Humber Passage Plan Adherence to COLREGS Availability of secondary channel (Foul Holme) used by some vessels in certain tides Regular stakeholder liaison including small vessel users	Limited displacement due to reduced sea room causing closer encounters with potential for minor collision between two vessels	3	1	2	2	2	Low	Medium	Medium	Medium	Reduced sea room leading to a high-speed collision between two passing vessels causing severe damage, pollution and loss of life.	2	5	5	5	5	Medium	Medium	Medium	Medium	Further research suggested to establish tidal limits for smaller vessels visiting the Project, with respect to potential effect on IOT operations. (Commercial rather than navigational safety issue.)

Hazard ID	Hazard Title	Hazard Description	Possible Causes	Mitigation Measures	Most Likely Outcome	Most Likely Outcome									Worst Credible Outcome	Worst Credible Outcome									Additional Comments
						Frequency	Consequences				Risk					Frequency	Consequences				Risk				
							People	Property	Planet	Business	People	Property	Planet	Port			People	Property	Planet	Business	People	Property	Planet	Port	
O7	Increased Grounding Risk for Other Vessels due to Displacement from the Project	Other (3rd party) vessels using the port have increased grounding risk due to displacement caused by the Project	Berth layout inc. exclusion zone impinges on existing traffic flows Human error, e.g., inadequate watchkeeping, distraction, fatigue, misjudgement, miscommunication Faulty Radar / AIS Poor visibility Failure to comply with VTS instructions Inadequate procedures Failure to comply with procedures	Berth aligned with IOT (including set back if larger exclusion zone required) Most vessels already avoid the planned exclusion zone Aids to Navigation Hydrographic Surveys Pilotage / PEC (where applicable) Simulations demonstrated sufficient space for IOT vessels displaced to north Passage planning VTS AISAids to Navigation Admiralty Charts - updated to include the Project Existing port controls, plans and procedures Availability of secondary channel (Foul Holme) used by some vessels in certain tides Regular stakeholder liaison including small vessel users	Limited displacement due to reduced sea room causing a proportion of vessels to pass marginally closer to shallow water or to have reduced under keel clearance during part of transit	2	1	2	2	2	Low	Low	Low	Low	Vessel displaced to a greater extent, possibly following an encounter, leading to vessel grounding, severe damage, pollution and loss of life.	1	5	5	5	5	Medium	Medium	Medium	Medium	

13 References

i Department for Transport (2012), *National Policy Statement for Ports*.

ii Department for Environment, Food & Rural Affairs (2011), *UK Marine Policy Statement*.

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iv Department for Transport (2018), *A Guide to Good Practice on Port Marine Operations*.

v International Maritime Organization (2018), *Revised Guidelines for Formal Safety Assessment (FSA) for Use in the IMO Rule-making Process.*

vi UKHO (2021), *ADMIRALTY Sailing Directions North Sea (West) Pilot*, NP54, 12th Edition

vii Associated British Ports (2023), Locations – Immingham: *Key Statistics and Berthing Information*.

viii Associated British Ports (2021), Standing Notice to Mariners S.H. 34, dated 16th August 2011.

ix Associated British Ports (2021), *Humber Passage Plan.*

x Associated British Ports, Humber Estuary Services (2022), *Notice to Mariners*,

xi Associated British Ports, Humber Estuary Services (2023),

xii Department for Transport (2022), *Port and domestic waterborne freight statistics: data tables (PORT).*

xiii HR Wallingford, Project Soleil – Ship Navigation Simulation Study, 2 May 2023.

xiv Maritime and Coastguard Agency (2022), *Guidance: MGN 401 (M+F) Amendment 3 Navigation: Vessel Traffic Services (VTS) and Local Port Service (LPS) in the UK*.