Technical Appendix 2.9

Navigation Risk Assessment

Ramboll UK Limited

Falmouth Docks & Engineering Company

Navigational Risk Assessment

December 2024





Innovative Thinking - Sustainable Solutions

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Document Information

Document History and Authorisation	
Title	Falmouth Docks & Engineering Company
	Navigational Risk Assessment
Commissioned by	Ramboll UK Limited
Issue date	December 2024
Document ref	R.4476
Project no	R/5385/01

Date	Version	Revision Details
29 February 2024	1	Issued for client review
26 June 2024	2	Issued for client review
30 August 2024	3	Issued for client use
02 December 2024	4	Issued for client use

Prepared (Author)	Approved (Quality Manager)	Authorised (Project Director)
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pp 		

Suggested Citation

ABPmer, (2024). Falmouth Docks & Engineering Company, Navigational Risk Assessment, ABPmer Report No. R.4476. A report produced by ABPmer for Ramboll UK Limited, December 2024.

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Notice

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Executive Summary

ABPmer has been commissioned by Ramboll United Kingdom Ltd to undertake a Navigational Risk Assessment, which details the marine risks associated with the construction and operational stages of the proposed development at Falmouth Docks.

Relevant guidance and information published by industry bodies and regulators has been reviewed and incorporated into the Navigational Risk Assessment process. Consultation has been conducted with stakeholders to draw out local user and regulator opinions. To inform the stakeholder group and this Navigation Risk Assessment, information defining the baseline navigational environment has been used, including a traffic assessment drawn from Automatic Identification System data and visual observations of non-Automatic Identification System craft, (A&P Falmouth, 2024a).

In total, 19 hazard scenarios were identified and assessed. A total of 12 hazard scenarios were identified for the construction stage and 7 hazard scenarios for the operational stage.

From the Navigational Risk Assessment process, 28 potential future controls (mitigation measures) were identified, split between the construction and operational stages of the proposed scheme. Through the considered application of the 28 different potential future controls identified across the demolition, construction and operational stages, Falmouth Docks and Engineering Company and the project team will be able to effectively manage the marine risks associated, ensuring activities are both tolerable and 'As Low As Reasonably Practicable'.

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1 Introduction

1.1 Project background

This Navigational Risk Assessment (NRA) has been prepared on behalf of Falmouth Docks and Engineering Company (FDEC) (the 'Applicant') for the proposed redevelopment and upgrade of facilities (the 'proposed development') at Falmouth Docks. The Statutory Harbour Authority (SHA) for Falmouth Docks is FDEC.

Falmouth Docks is located in Falmouth Inner Harbour, part of the Fal Estuary, located in the county of Cornwall. FDEC as Harbour Authority is owned and operated by the A&P Group, which is one of the UK's leading ship repair and conversion companies. The Falmouth Docks facility is known for being one of the largest ship repair complexes in the UK, located in one of the world's largest natural deep-water harbours. Falmouth Docks includes three graving docks and can accommodate ships up to 100,000 Deadweight Tonnage (DWT), offering a range of marine repair services with extensive on-site engineering, electrical, and fabrication capabilities. As well as having engineering facilities, FDEC has cruise ship facilities and cargo handling facilities; with capability of managing a wide range of cargos from bulks to break bulk and containers.

The proposed development would redevelop and modernise the existing facilities at Falmouth Docks to reinstate full alongside berth capability and increase berth capacity. The objectives of the proposed development are to repair and update the currently poor condition dock infrastructure in order to maintain existing business and future proof the docks with respect to cruise capacity, cargo capacity and renewable floating offshore wind (FLOW) (supporting the offshore wind market). The NRA considers potential marine risks that arise through demolition and construction activities and the subsequent marine use of the proposed development for its intended operation. A key output of this study is a set of Hazard Logs which support the findings of the NRA.

1.2 Scope of work

The full planning application and marine licence application (MLA) would comprise the following redevelopment activities:

- Pocket dredge of berth areas to achieve required under keel clearance for larger cruise vessels (up to Excellence class) and the FLOW renewable energy device under keel requirements (considered to be -10.5 m Chart Datum (CD));
- Removal of foul ground within areas of the former Kings and Empire Wharves;
- Surface skim of seabed on eastern side of the site to maintain -5.5 m (CD);
- Demolition of the remaining existing Western Wharf timber piles and above surface infrastructure;
- Construction of a new Western Wharf suspended deck structure;
- Demolition of the Northern Arm concrete structure and substructure to below seabed level and removal of the gang walkway and old timber piles that are located west of this structure;
- Construction of a suspended deck structure (Northern Wharf) in the existing 90 m gap between Queen's Wharf and the Northern Arm to create a longer functional wharf length;
- Upgrades to the existing Queen's Wharf structure;
- Extension of the Queen's Wharf suspended deck structure 50 m westward;

- Installation of a 290 m deck (the 'FLOW Deck') to facilitate a FLOW device;
- Upgrades to the existing Duchy Wharf structure to facilitate a FLOW device; and
- Demolition of on-site buildings and re-configuration of Falmouth Dock activities.

The proposed development would modify vessel traffic patterns in the Carrick Roads and Fal Estuary areas during the demolition and construction and once the development is completed. These alterations create the need for an NRA to investigate the changes to the marine environment from a navigation perspective and to assess the associated risk during demolition and construction activities and the subsequent marine operations associated with the completed development.

The NRA establishes the existing baseline through the collection of data from AIS-A, AIS-B, MetOcean (wind and wave) modelling, the Royal Yacht Association's Density Atlas database, Closed Circuit Television (CCTV) coverage, FDEC berthing records, and incident records from the Royal National Lifeboat Institution (RNLI), Maritime Accident and Investigation Branch (MAIB) and FDEC. The proposed development was assessed through a Hazard Identification (HAZID) and Risk Analysis workshop, involving port, wider harbour, and project stakeholders. This workshop was supplemented by expert advice and assessment prior to finalisation.

1.3 HAZID and Risk Analysis workshop

ABPmer conducted a HAZID and Risk Analysis workshop, on 11 January 2024, to engage with stakeholders and allow their input to the proposed development. The attendees included representatives of FDEC, Falmouth Harbour Commissioners, World Fuel Services, Port Pendennis Marina, Falmouth Harbour Pilots and the project team from Ramboll UK.

The aim of the workshop was to identify and better understand potential hazard scenarios associated with the proposed development from a navigational context during demolition, construction, and the completed development stages. This included the causes that could lead to these hazards and the embedded (existing) controls currently in place along with the perceived risk outcomes for people, planet, property, and port. Workshop attendees considered future (potential) controls relevant to each hazard scenario. The outcome of this exercise created a set of potential future additional controls for the consideration of the SHA to implement as deemed appropriate.

1.4 Study area

Falmouth Harbour is located on the south coast of Cornwall on the Fal Estuary. Falmouth Docks is located near the mouth of the Fal Estuary, in Falmouth's Inner Harbour. The extent of the study area considered for this NRA is shown at Figure 1 and was selected as it encompasses the shipping traffic relevant to the proposed development and the associated vessel movements which may be required, either by ships directly associate with the proposed development or by vessels potentially impacted. Specifically, the area chosen encompasses all of the Falmouth Docks SHA and a large proportion of the Falmouth Harbour Commissioners' SHA area without extending into other nearby SHAs including Truro, St Mawes, and Penryn. Further, the selected study area also considers utilisation of Falmouth Bay as there is potential that sites in this vicinity are used for the relocation of dredge material.

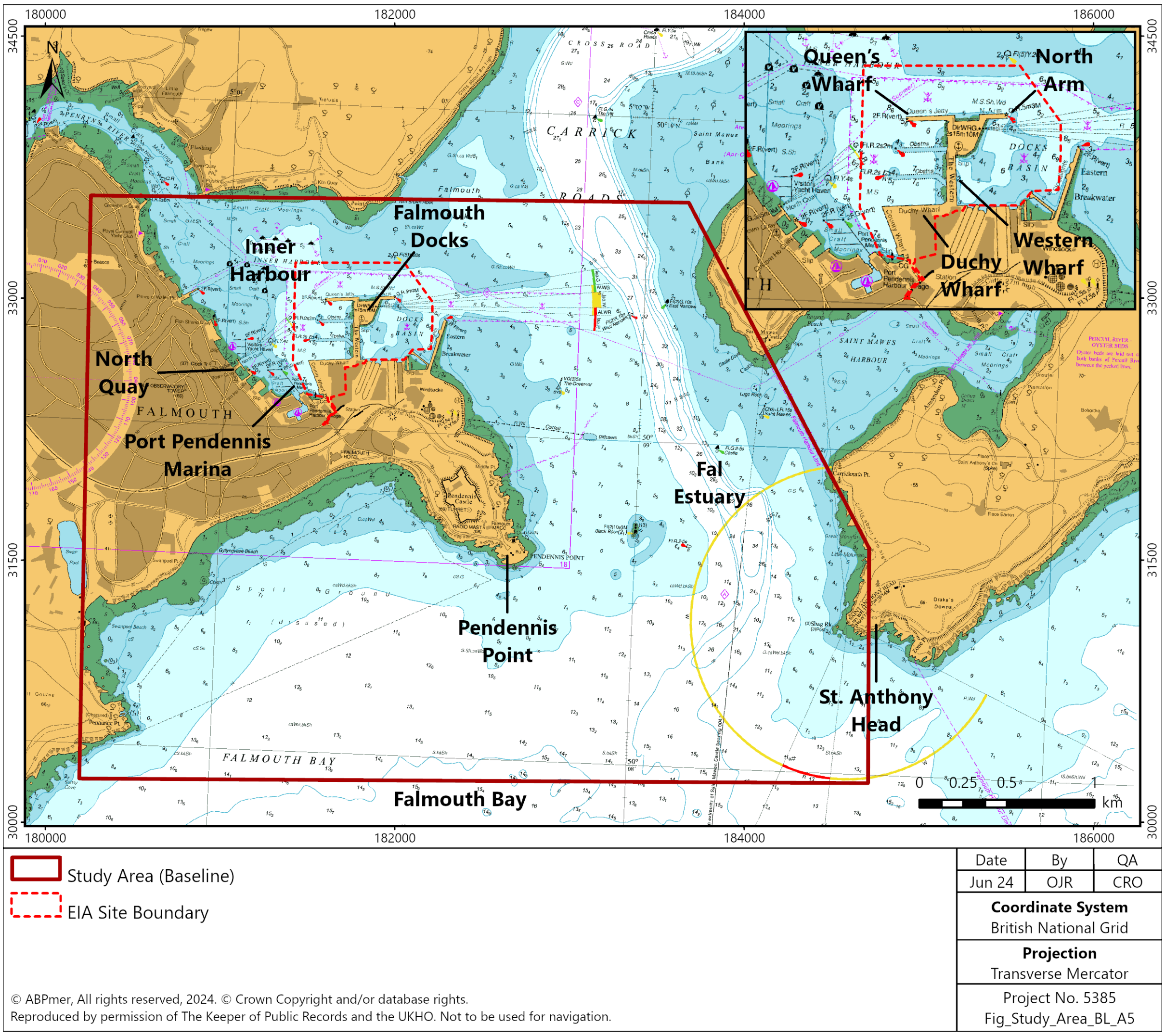
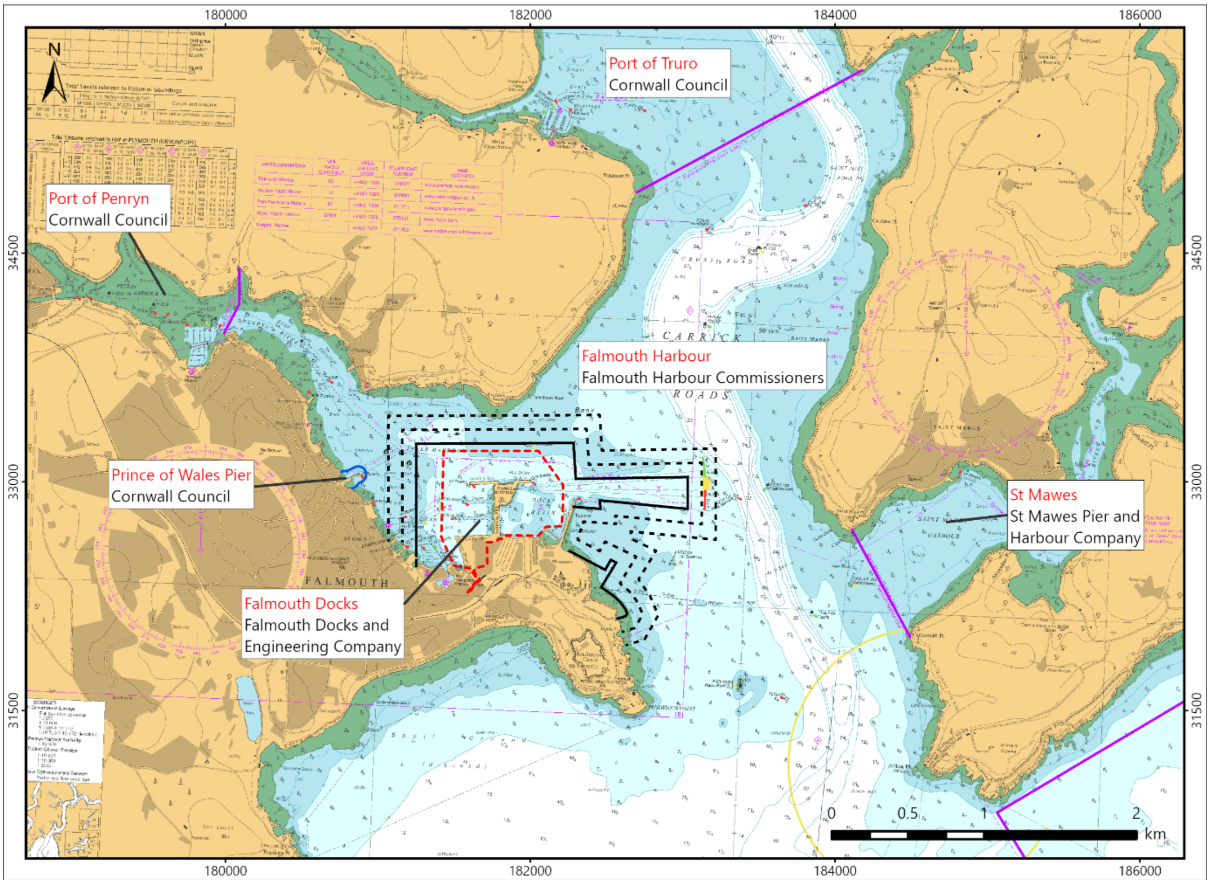


Figure 1. Study Area

The vessel approach into the Fal Estuary is 1 nautical mile wide, flanked by Pendennis Point to the east and St. Anthony Head to the west. Continuing north, the Fal Estuary leads to the Carrick Roads. This part of the estuary is particularly spacious, deep and provides sheltered anchoring spots. Vessel Masters can be allocated a variety of anchorage points within Carrick Roads depending on the vessel's size, draught and the prevailing wind and tidal conditions. The Inner Harbour provides good shelter from prevailing conditions due to the surrounding local topography which comprises large hills and cliffs and several anchorage locations within the Inner Harbour. The seabed is characterised with mud and sand providing good holding material for vessels at anchor.

FDEC is one of four SHAs in the Fal Estuary. FDEC's harbour limits are shown in black in Figure 2. In addition to the limits shown in Figure 2. the Falmouth Docks Act 1959 (Section 24 (1)) extends FDEC's powers to a further 200 yards seaward beyond the limits shown in Figure 2 for those vessels that are approaching or leaving the area within FDEC's harbour limits. Immediately adjacent to FDEC's harbour limits is the SHA of Falmouth Harbour Commissioners (FHC) who are a Trust Port providing harbour patrols, a pilot boat service and conservancy functions. To the north of the site is the Port of Truro, to the west of the site is the Port of Penryn and within Falmouth Inner Harbour is the Prince of Wales Pier, all of which are Municipal Harbour Authorities being owned and operated by Cornwall Council. To the east of the site is the Harbour Authority of St Mawes, which like FDEC, is a privately-owned harbour. The combination of different Harbour Authorities in the Fal Estuary lends itself to a collaborative and cooperative approach to marine safety. Additionally, FHC is the Competent Harbour Authority (CHA) for the approaches to the Fal Estuary and the Inner Harbour area through which traffic passes before arriving at FDEC's SHA, for which FDEC is the CHA, as well as in the area 200 yards from FDEC's harbour limits as set out in the Falmouth Docks Act 1959. The layout of harbour and harbour limits is shown on Figure 2.



EIA Site Boundary	Falmouth Harbour Limits
Falmouth Dock Limit	Prince of Wales Pier Limits
FDEC Extended Area (100 yards & 200 yards)	

Date	By	QA
Oct 24	OJR	CRO

Coordinate System
British National Grid

Projection
Transverse Mercator

Project No. 5385
Fig_SHAs_A5

Figure 2. Falmouth Harbour and Dock limits

1.5 Policy and guidance

1.5.1 Policy

The UK national standard for safe and efficient port and maritime facility operation is the Department for Transport's 'Port Marine Safety Code' (PMSC) (DfT, 2016) and its accompanying guidance document 'A Guide to Good Practice on Port Marine Operations' (GtGP) on which this NRA methodology is based (DfT, 2018).

Additionally, principles from the International Maritime Organization (IMO) Revised Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule making process (IMO, 2018) have been considered as it provides supplementary information with regard to navigational risk. It should be noted that this document covers a wide range of guidance advice for marine activities, not all of which are applicable or carried across to the port marine context in the UK.

1.5.2 ALARP and tolerability principles

As Low As Reasonably Practicable (ALARP): The PMSC defines the term 'ALARP' as being 'as low as reasonably practicable', (DfT, 2016). 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 (DfT, 2016) specifically references ALARP as an underpinning rationale for Marine Safety Management Systems (MSMS) and marine risk assessments.

Risk assessment is based on a comprehensive and formal assessment of hazards and risks with a view, following assessment and implementation of mitigation where required, to eliminate hazards and risks or to reduce them to the lowest possible state, as far as is reasonably practicable. Where a project is proposed which may alter the navigable environment, the promoter of the scheme should consult with those likely to be involved in or affected by such alterations and are responsible for managing the risks. The overriding aim is to ensure that any consequential risk is reduced to meet the standard of ALARP.

The PMSC's Guide to Good Practice (DfT, 2018) (GtGP) 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 more substantial risk outcome against risk tolerability (See section 4.5 for Risk Tolerability), it needs to be taken into account so as to ensure the overall risks are ALARP. Greater emphasis is placed on significant risks to ensure that the more significant risk outcomes are mitigated.

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

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

Further, 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.",*

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

- Is the risk tolerable to the competent/appropriate authority: and
- Is the risk mitigated to an 'ALARP' state.

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. Determining the risk tolerability is the responsibility of the competent authority with jurisdiction of the area in which the scheme or development is occurring.

2 Navigation Baseline

2.1 Introduction

The following section presents the baseline information for commercial shipping, military or law enforcement, fishing vessels and recreational craft in the study area. Where relevant, factors relating to the proposed development and the subsequent operation have been highlighted. The following elements are considered in the baseline:

- Statutory responsibilities and management procedures;
- Vessel services;
- Aids to Navigation;
- MetOcean conditions;
- Marine traffic; and
- Marine incidents.

2.2 Statutory responsibilities and management procedures

The proposed development is located within FDEC's statutory harbour limits. FDEC in its capacity as the 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.

FDEC 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 and procedures. The MSMS for FDEC details how its statutory duties are met, through the integration of plans, processes, and procedures.

The CHA for the proposed development area is FDEC. However, access to FDEC's CHA (and SHA) from sea must be gained via transit of FHC's CHA for which the two organisations have an Agency Agreement in place (A&P Falmouth, 2024b). Pilotage Directions are in place identifying which vessels require a Pilot. A Pilotage Exemption Certification (PEC) scheme is also in place for any *bona fide* ship's deck officer who demonstrates that they have the requisite skills, experience, and local knowledge to pilot their vessel. The Falmouth Pilotage Area is defined as the area below the level of high water that exists to landward of an imaginary line drawn between Black Head and Dodman Point (Falmouth Pilot Services, 2022). FDEC has entered an Agency Agreement with FHC, as a CHA, to allow them to exercise pilotage functions on their behalf within the FDEC's SHA area.

FDEC is also the Local Lighthouse Authority (LLA) for their area of jurisdiction by virtue of Section 193 of the Merchant Shipping Act 1995. This provides the responsibility for the maintenance of navigational marks and lights within the Authority's area. Approaches to the Falmouth Harbour are managed by FHC as the LLA. Both FHC and FDEC worked collaboratively to review the Aids to Navigation (AtoN) in the area during 2023.

2.3 Vessel services

The FHC Pilotage Directions (Falmouth Pilot Services, 2022) define the requirements for compulsory pilotage. The Pilotage Directions specify the circumstances under which Pilotage Exemption Certificates (PECs) are issued and administered in the area. Vessels subject to compulsory pilotage within the compulsory pilotage area include:

- All vessels exceeding 180 metres (m) in length when navigating north of a line drawn between Black Head and Dodman Point (Zone A).
- All vessels in commercial use exceeding 30 m in length when navigating west of a line drawn between Rosemullion Head and Position Lat 50 03.35N Long 5 01.60W (WGS 84) (Zone B).
- All vessels exceeding 75 m when navigating north of a line drawn between Zone Point and Rosemullion Head and south of a line drawn between Messack Point and Penarrow Point (Zone C) or elsewhere in the Pilotage Area if navigating within 1.0 mile of the shore.
- All vessels exceeding 60 m navigating north of a line drawn between Messack Point and Penarrow Point (Zone D) or in the Penryn River west of a line drawn between Prince of Wales Pier and Flushing New Quay.
- All vessels navigating within the designated Pilotage Area carrying dangerous or polluting goods as defined in the MS reporting regulations 1995.
- All vessels in commercial use navigating within the Pilotage Area not equipped with corrected Admiralty Charts numbers 154, 32, and 18 (or equivalent) as required to cover the entire passage.
- All vessels exceeding 50 m entering or leaving a dry dock.
- All manned vessels exceeding 50 m using the services of a harbour tug.
- Vessels of any size (except those specifically exempted) when directed by the harbour master or dock master in the interests of the safety of the vessel, other vessels, persons, the port, or its infrastructure. (Falmouth Pilot Services, 2022)

Port Operations in Falmouth, managed by FDEC, are supported by a 24-hour towage service for assistance within the dock, harbour, river, and extended bay areas. The current towage fleet includes two identical Voith tractor tugs, each capable of a 43-tonne bollard pull, alongside another Voith tractor tug with a 23-tonne bollard pull capacity. An additional Voith tractor tug, also with a 30-tonne bollard pull, is available upon request. Furthermore, the service is supported by two workboats, one of which is equipped to transport personnel and deliver supplies or equipment to vessels located in the river or bay, facilitating operations throughout the estuary.

2.4 Aids to Navigation

Within the study area there are a range of AtoN including marked channels, cardinal buoys, a directional light, and special marks, Figure 3.

The buoyed channel is used to indicate where it is safe for vessels to navigate and will generally keep to the deep water in an area. The channel is lined with lateral marks which are either green or red to indicate which side a vessel should pass them. The lateral marks used within the study area are buoys and land-based lights. To differentiate the buoys their shape is either a 'can' shape for Port and a 'cone' shape for Starboard. In addition, the light which is displayed will be different for each mark. The marked channel begins in the approaches between the two headlands (Pendennis Point and St Anthony Head) and continues north up Carrick Roads and ends with the interception of the Directional Sector light from the Inner Harbour. This Sector Light guides vessels to the Falmouth Dock in the Inner Harbour.

The cardinal buoy to the south-east of Falmouth Dock is an Easterly Cardinal Mark prompting vessels to remain in the deep navigable water. Finally, the isolated danger mark identifies Black Rock which is a prominent feature in the approaches to Falmouth Harbour.

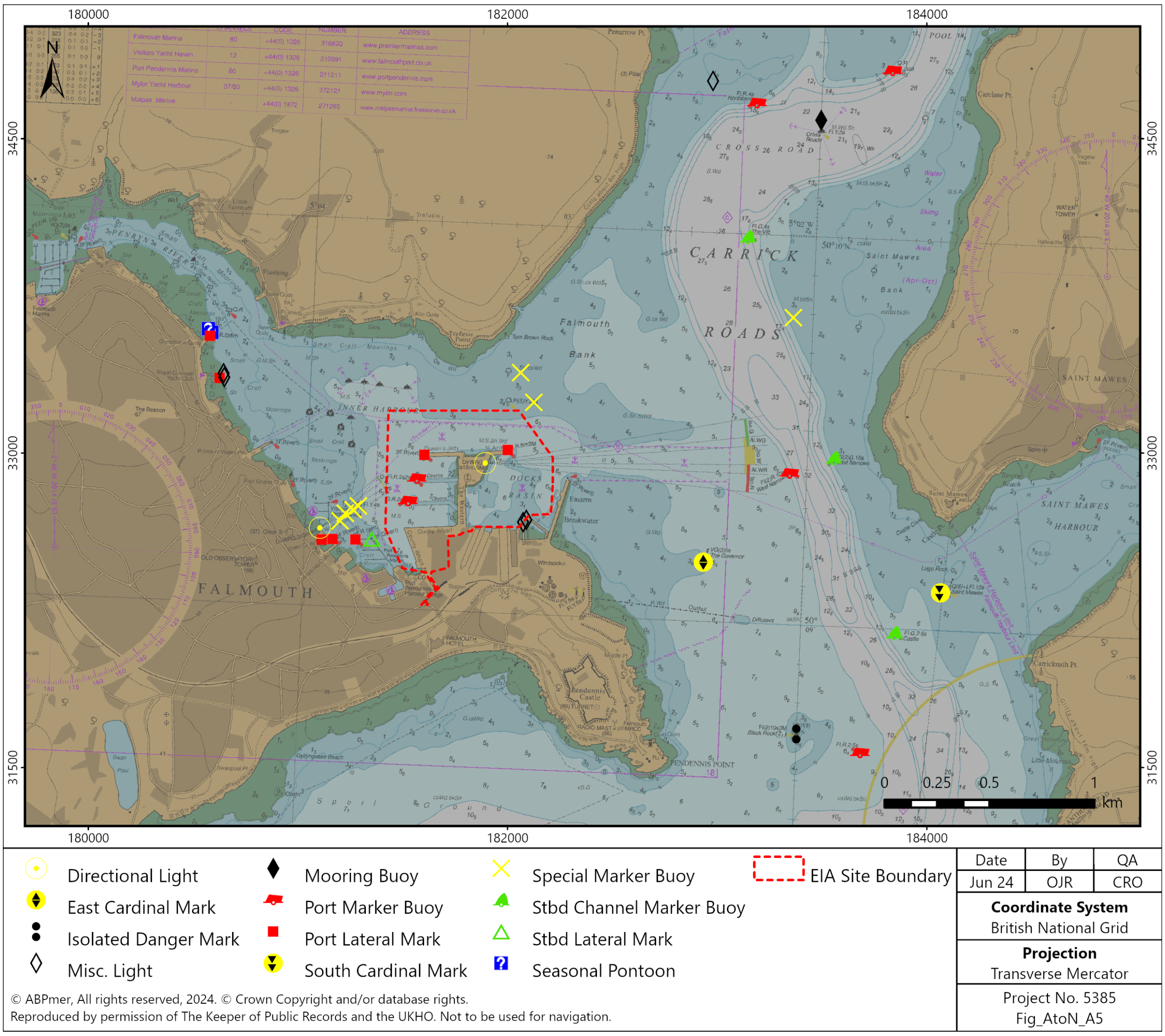


Figure 3. Falmouth Aids to Navigation

2.5 MetOcean conditions

This section details the wind and wave characteristics of the study area. It must be noted that the data shows conditions within Falmouth Bay and not the harbour itself. This means that the prevailing wind conditions will likely be reduced within the harbour due to sheltering from the topography.

2.5.1 Waves

Figure 4 shows a wave rose diagram south of the Fal Estuary entrance. This provides an indication of wave activity in the harbour approaches.

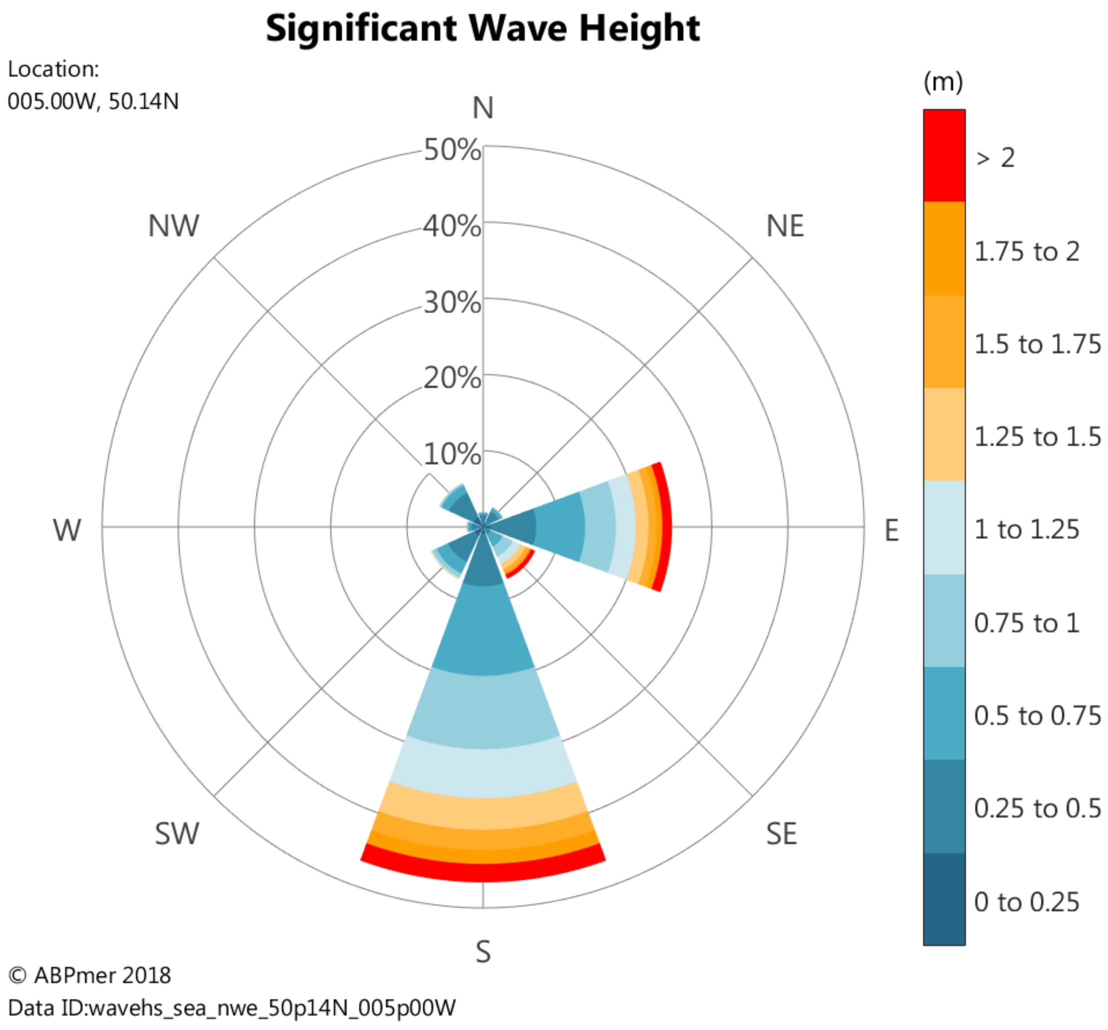


Figure 4. Wave rose for Falmouth approaches

It can be seen from Figure 4 that waves are experienced from the south 45% of the time and east 25% of the time with other directions producing negligible amounts of swell. The most frequent wave height being 0.5 m to 0.75 m from the south. The highest frequency of larger waves (greater than 2.0 m) also comes from the south. The harbour provides a natural enclosed water area which is protected from the prevailing southernly wave conditions.

2.5.2 Wind

Figure 5 shows a wind rose diagram south of the Fal estuary entrance. This provides an indication of wave activity in the harbour approaches.

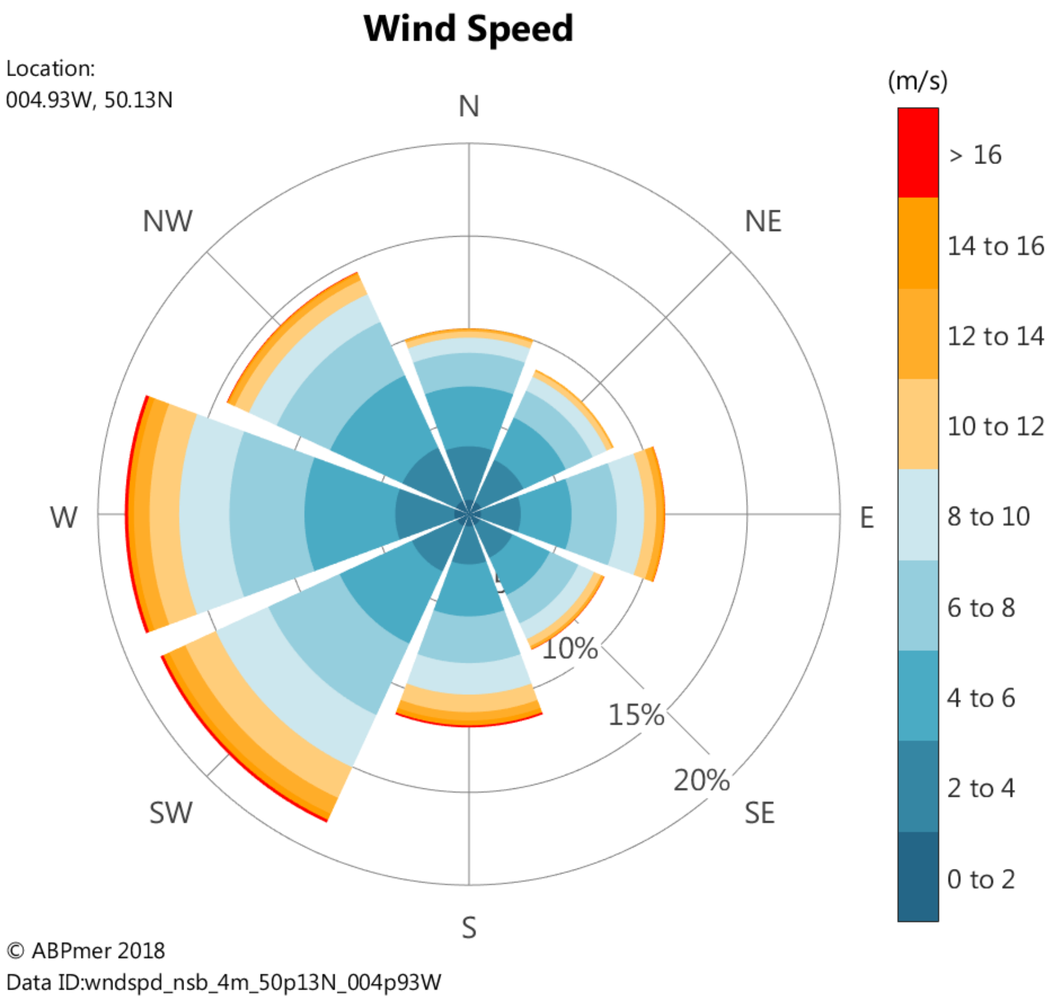


Figure 5. Wind rose for Falmouth approaches

Figure 5 identifies that the wind is predominantly from the west, and to a marginally lesser extent from the south-west. The strongest winds of greater than 16 m/s (Beaufort Wind Force 7) are also predominantly from the west and south-west and occur relatively infrequently. The local topography does provide shelter from wind from the west and south-west to some extent and it is anticipated that winds experienced from this direction in Falmouth Bay will be lesser in the Harbour area.

2.6 Marine traffic

This NRA has used the FDEC Traffic Analysis Report (A&P Falmouth, 2024a) to conduct its marine traffic analysis and to help determine any potential challenges that may arise due to marine traffic within the study area. The FDEC Traffic Analysis Report captures Automatic Identification System (AIS) movements within FDEC's SHA across two separate periods to ensure coverage of both a quiet winter period and a busier summer period which is considered robust for assessment purposes. The winter data was

captured from 24 October 2023 to 07 November 2023 (midday to midday) which represents 14 days of continuous AIS coverage. The summer data was captured between 14 August 2023 to 28 August 2023 (midday to midday) in addition. The FDEC Traffic Analysis Report also includes a CCTV vessel traffic review over the same winter period to enable a comparison between AIS data and non-AIS vessel traffic. From this, FDEC concluded that AIS data over this period represented approximately 10% of the total vessels observed and therefore under-represents the total number of vessels in the area. However, AIS data is considered to provide adequate baseline context for the NRA. Where appropriate, the AIS data is supplemented with FDEC visually observed data and berthing plan information.
Table 1 shows the count of AIS movements captured in both periods.

AIS signals are broadly classified as 'Class A' and 'Class B'. AIS-A is carried by international voyaging ships with Gross Tonnage (GT) of 300 or more tonnes, all passenger ships regardless of size, fishing vessels 15 m or more in length overall (operating within UK waters) and certain categories of workboats. The use of AIS-B is not compulsory but may be carried by other vessels, including smaller commercial craft, the fishing sector, and recreational vessels. Both AIS-A and AIS-B data have been used within the FDEC Traffic Analysis Report and have been classified into the following eleven vessel categories, which are taken directly from the AIS data transmissions:

- Other/ Unknown;
- Search and Rescue craft;
- Pilot, Port or Tug boats;
- Diving or Dredging vessels;
- High-speed craft;
- Military / Law Enforcement vessels;
- Passenger ships;
- Cargo ships;
- Tanker or bunker vessels;
- Fishing vessels; and
- Pleasure and Sailing craft.

Table 1. Vessel AIS Movement Count (2023)

AIS movements - 14 day period, per vessel type	October/November	August
0 - Other/ Unknown	2	10
1 - Search and Rescue craft	8	14
2 - Pilot, Port or Tug boats	97	161
3 - Diving or Dredging vessels	0	0
4 - High speed craft	2	0
5 - Military / Law Enforcement vessels	2	2
6 - Passenger ships	3	1
7 - Cargo ships	6	3
8 - Tanker ships	5	6
9 - Fishing vessels	1	1
10 - Pleasure and Sailing craft	1	13

Figure 6 and Figure 7, display the cumulative findings from the FDEC AIS Traffic Study Report (2024) for the winter and summer periods, respectively. At a high level, these figures show that there is a greater concentration of vessels that utilise FDEC or pass through their SHA during the summer period when compared to the winter period.

Figure 6 FDEC AIS Traffic Study - Winter

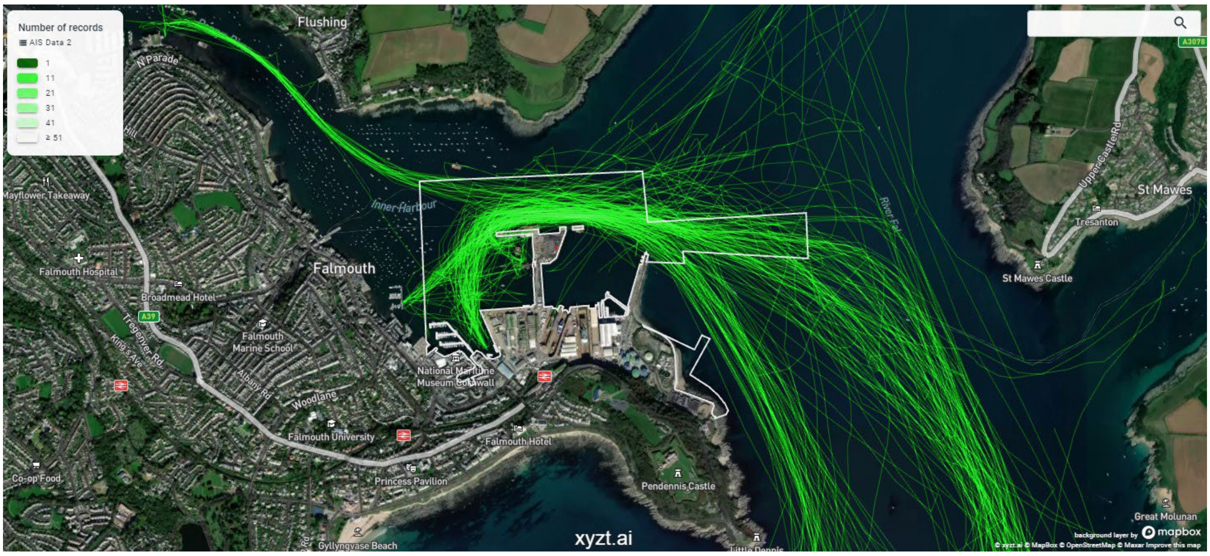


Figure 7 FDEC AIS Traffic Study - Summer

2.6.1 Other/ Unknown AIS

They vast majority of transits of other or unknown AIS category were in the summer period. Movements were often from the outer harbour to the vicinity of County Wharf. These vessels have not configured their AIS to display their vessel type, and therefore it is not possible to categorise them further. Their inclusion presents a full account of data, and it is speculated (based on past experience) that most Other/Unknown vessels are small workboats or fishing craft.

2.6.2 Search and Rescue AIS

During both the summer and winter periods there is evidence of some activity being conducted by Search and Rescue craft. These vessels originate and return to the RNLI Falmouth lifeboat station located immediately south of County Wharf and therefore pass through FDEC's SHA. In the summer most transits are to the outer harbour. The highest area of activity in the winter was around the Governor eastern cardinal mark in the main channel of the Fal Estuary.

2.6.3 Pilot, Port or Tug AIS

A large number of transits were observed from pilot vessels, port craft and tugs in both summer and winter periods, with the larger proportion supporting the increased vessel traffic during the busier summer period. Pilot boats generally operate out of the North Quay (a small quay to the west of FDEC, shown on Figure 2) and the adjacent marina, so the majority of transits begin and end there. The vessels cross the Inner Harbour passing to the north of the Queen's Wharf through FDEC's SHA before heading south to the Outer Harbour. There is also vessel traffic to the north of Duchy Wharf that can be observed in the FDEC Traffic Analysis Report . In the summer period there is considerable transits up to Penryn that do not occur in the winter period.

2.6.4 Diving or Dredging AIS

There was no diving or dredging AIS movements in either observation period.

2.6.5 High Speed Craft AIS

Two AIS transits by a high-speed craft were observed in the winter period. The transit was from a vessel entering or leaving No.1 Dry Dock. This suggests it either entered the dry dock prior to the observation period or stayed in the dry dock after the end of the observation period. There were no AIS transits for high-speed craft in the summer period.

2.6.6 Military / Law Enforcement Operations AIS

Two transits were observed during each period from military/law enforcement vessels. This was the incoming and outgoing voyage of a vessel from the vicinity of Duchy Wharf to the Outer Harbour in the winter. The summer transits are similar but from Queen's Wharf.

2.6.7 Passenger Ships AIS

The AIS data shows three AIS transits for passenger vessels in the winter period but only one transit in the summer. The summer transit was entering or exiting No.4 Dry Dock. There was also a transit to the dry docks in the winter and an additional transit to and from County Wharf. As set out in Section 2.6.12, cruise ship berthing information provided by FDEC shows 48 cruise calls to the port for 2023, with 36 of these berthing alongside, and 12 cruise tender calls.

2.6.8 Cargo Ships AIS

All AIS transits in both periods either sailed or berthed at County Wharf passing through FDEC's SHA to the outer harbour. There were six AIS movements in the winter and three in the summer.

2.6.9 Tanker Ships AIS

There were 11 AIS transits (five in winter and six in summer) by tankers in the FDEC's SHA over both observation periods. The majority berth at the Eastern Jetty on the Eastern Breakwater where a small oil terminal is located which is controlled by Falmouth Petroleum who operate a bunkering service for vessels offshore or alongside. The remaining AIS transits are likely to be providing bunkers for vessels on Queen's Wharf or Duchy Wharf.

2.6.10 Fishing AIS

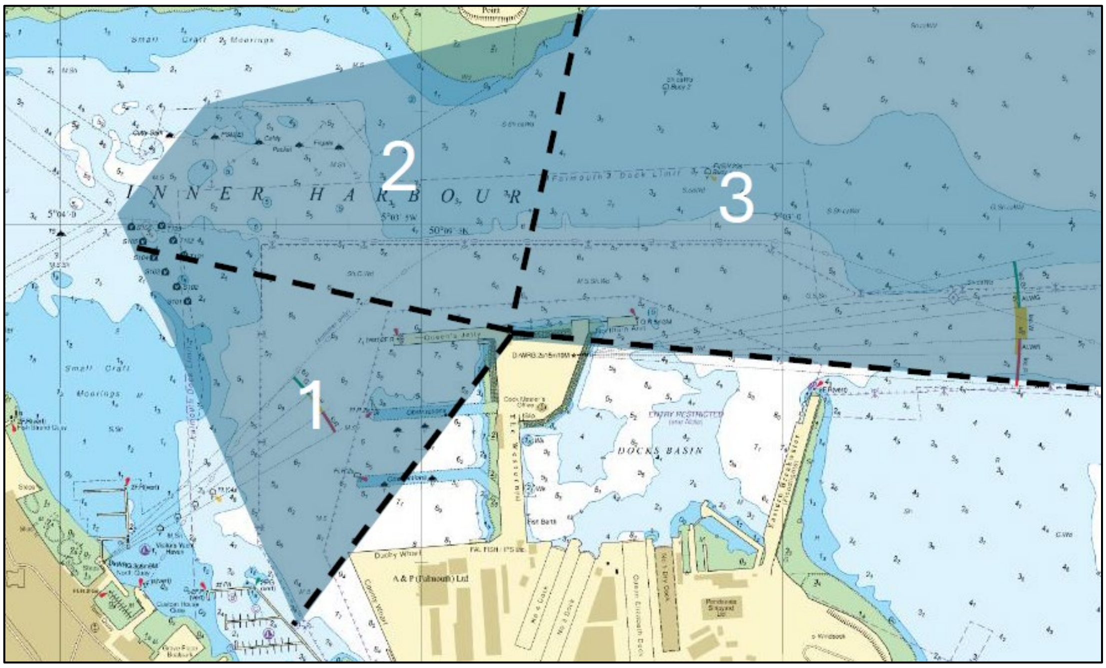
There was only one fishing vessel that transmitted AIS that passed through FDEC's in each period. Both originated from Penryn River before heading to Falmouth Outer Harbour passing through FDEC's SHA.

2.6.11 Pleasure and Sailing AIS

Of the 14 AIS transits recorded for pleasure and sailing craft 13 of them were in the summer period. These craft operated all across the Carrick Roads and towards the outer harbour. Transits often began from the marina to the west and so pass through the FDEC's SHA to north of Queen's Wharf.

2.6.12 Visually Observed Marine Traffic

Visual observation was also used in the winter period only (due to limitations of the CCTV footage available) to capture vessels or craft which do not carry AIS transmitters (period from 12 October to 7 November). All vessel movements in this period were observed from the CCTV cameras situated at Queen's wharf and were recorded and digitised on a GIS platform. Vessels were monitored via three different cameras that covered the extent of the Inner Harbour, North Queen's and main approach channel as shown in Figure 8 (from the FDEC Traffic Analysis Report). Comparison of CCTV observations to AIS data recorded in a similar area allowed FDEC to make an accurate comparison between AIS data and non-AIS vessel traffic. FDEC reported that AIS data accounted for approximately 10% of the total observed vessel traffic movements. Refer to the FDEC Traffic Analysis Report for further detail.



Source: A&P Falmouth, 2024a

Figure 8. CCTV Coverage

Vessels or craft visually observed were classified into the following categories:

- Leisure Sailing;
- Leisure Motorboat;
- Passenger Ferry;
- Harbour or Port Craft;
- Kayak, Stand-Up Paddleboard (SUP) or Rowing; and
- Other.

Table 2. Visually Observed Movement Count and Percentages over Winter Period

Vessel/Craft Type	Count	%
Leisure Sailing	311	22%
Leisure Motorboat	359	23%
Passenger Ferry	352	22%
Harbour or Port Craft	224	20%
Kayak, SUP or Row	110	8%
Other	71	5%

Table 2 details the total count of visually observed movements and their percentage of the total movements observed. Leisure Motorboat was the mostly frequently sighted followed by Passenger Ferry and Leisure Sailing. While it is expected that these counts will be more than the AIS movements, visually observed movements will also include transits that did not pass through FDEC's SHA.

Leisure motorboat and leisure sailing movements captured by visual observation are far higher than the AIS movements due to there being no requirement for recreational vessels to carry AIS transmitters. Port Pendennis Marina and Falmouth Haven marina see the most activity from pleasure and sailing craft but there are also sizeable number of movements from the Penryn River where Falmouth Marina is located. The majority of transits cross through the FDEC's SHA and its approach channel. Cruise ship berthing information provided by FDEC shows 48 cruise calls to the docks for 2023, with 36 of these berthing alongside, and 12 cruise tender calls.

Passenger ferries observed visually included the St. Mawes ferry which operates from Falmouth Pier and Falmouth Custom House Quay. The ferry provides a year round service to passengers with up to three ferries an hour in the summer and an hourly service in the winter months. The ferry route passes through FDEC's SHA to the north of Queen's Wharf.

Kayak, SUP and rowing craft movements were also captured visually but do not fall under any AIS category. Once again, they operate from the two Falmouth marinas before heading across to St. Mawes or the Outer Harbour. These types of craft were far more frequently sighted on the weekends.

2.6.13 Royal Yachting Association (RYA) information

The RYA has provided a set of resources that can be used in technical work (such as within this NRA) to further understand its members' activity. The following sections present a summary of this information for the study area. Figure 9 presents the RYA Coastal atlas of recreational boating.

Yachting covers a variety of boating activities, which for the purposes of this NRA include motor boating, keelboat cruising and racing. The Fal Estuary is a major centre for recreational boating with more than 5,500 vessels berthed on permanent facilities within the estuary as a whole. Within Falmouth, there are moorings throughout the Inner Harbour and three large marinas, namely:

- Port Pendennis: 80 outer pontoon berths, 70 inner marina berths.
- Falmouth Haven: 60 marina berths, approx. 600 moorings in the Inner Harbour.
- Falmouth Marina: 320 marina berths.

The main yacht and sailing clubs in the study area include Royal Cornwall Yacht Club located in Falmouth and Flushing Sailing Club located on the north coast of the Inner Harbour.

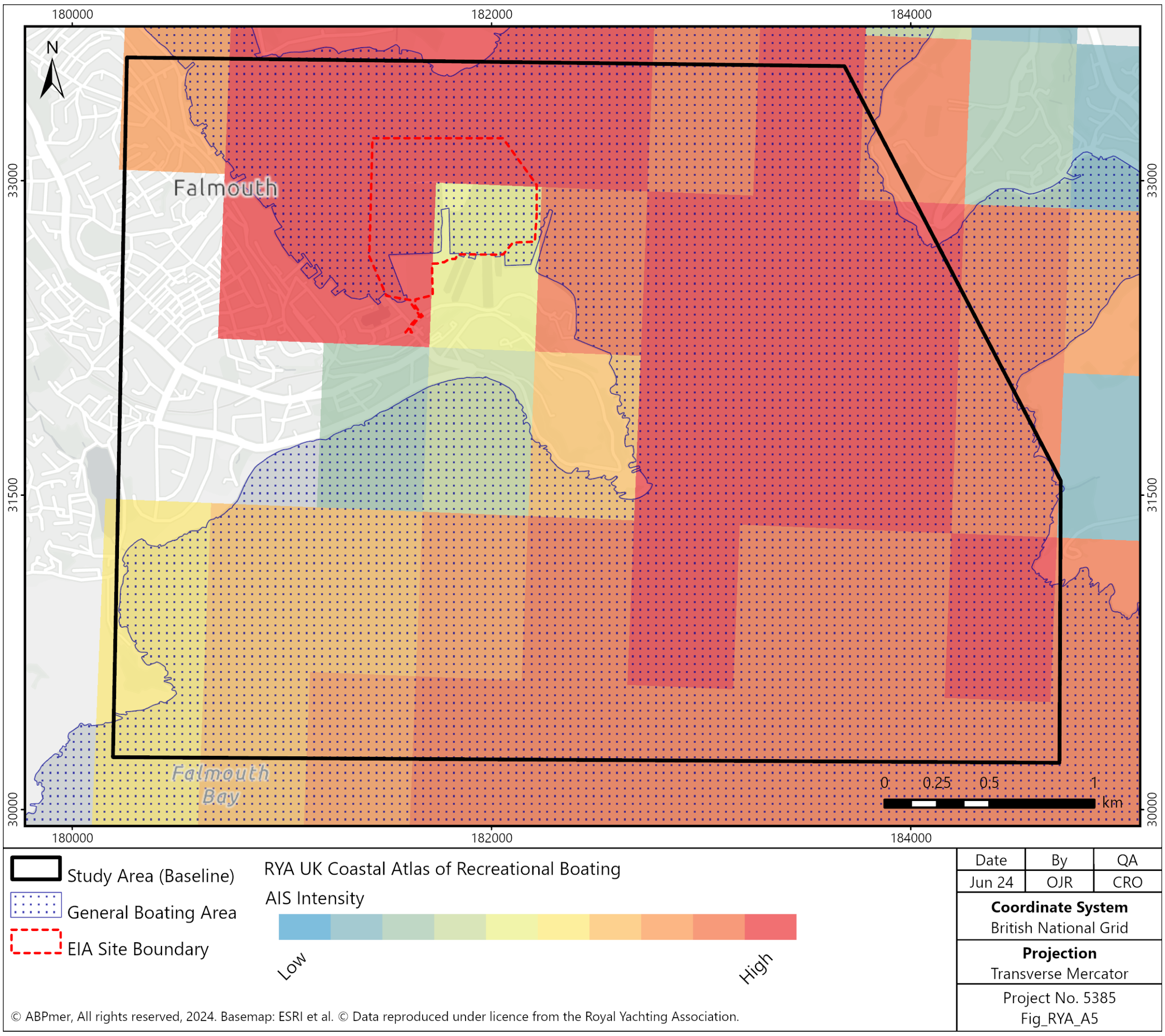


Figure 9. Royal Yachting Association Density Atlas

2.7 Marine incidents

This section reviews the marine incidents that have been reported within the study area over a period of 10 years between 01 January 2013 and 31 December 2022. Data has been collected from three sources, namely:

- Maritime Accident and Investigation Branch (MAIB);
- Royal National Lifeboat Institution (RNLI) call out data; and
- FDEC Incident Data.

These datasets hold the details of all reported marine safety incidents and other occurrences which have potential significance to navigational safety. The data collected is shown in Table 3 to Table 5. The reported incidents have also been mapped onto a local chart and colour coded as per their category to determine possible areas where certain incidents are more likely to occur (Figure 10 to Figure 12).

There are some incidents which are duplicated across the three datasets, and which cannot be accurately removed . For this reason, the three datasets have been reported individually within the NRA, rather than reporting total incident rates.

Table 3. MAIB Marine incident summary for the study area (2013 to 2022)

Incident Category	Year											Annual Frequency
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	
Capsize/ Sinking	0	0	0	0	1	0	0	1	0	1	3	0.3
Collision	0	2	0	0	0	0	0	1	2	1	6	0.6
Equipment failure (vessel)	0	0	1	0	1	0	1	1	2	1	7	0.7
Fire/Explosion	1	0	0	1	0	0	0	0	1	1	4	0.4
Grounding	1	0	0	0	0	2	0	0	0	0	3	0.3
Leaks/Swamping	0	0	0	0	0	0	0	0	1	0	1	0.1
Other nautical safety	0	2	0	0	0	0	0	0	1	2	5	0.5
Person in distress	2	0	2	2	3	3	1	2	2	4	21	2.1
Persons in the water	0	0	0	0	0	0	0	0	2	0	2	0.2
Grand Total	**4**	**4**	**3**	**3**	**5**	**5**	**2**	**5**	**11**	**10**	**52**	**5.2**

Table 3 presents MAIB incident records and the location of MAIB accident/incident reports are shown at Figure 10. It identifies there was a total of 52 reported incidents between 2013 and 2022. This equates to an average annual frequency of 5.2 reportable MAIB incidents per year, within the study area. Ports and vessel operators are required to report certain incidents to the MAIB, and these are typically incidents which are more serious in nature or had the potential to be more serious. The most frequently reported incident type was 'Person in distress' which occurred 21 times over the 10-year period. The next most frequently reported category was 'Equipment failure (vessel)' with a total of 7 reports. These events are generally propulsion or engineer failures that result in near misses.

Table 4. RNLI Marine incident summary for the study area (2013 to 2022)

Incident Category	Year											Annual Frequency
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	
Capsize/ Sinking	0	1	1	0	2	1	1	0	1	0	7	0.7
Collision	0	0	1	0	1	1	0	1	3	1	8	0.8
Equipment failure (vessel)	5	7	9	10	1	6	2	4	4	2	50	5
Fire/Explosion	0	1	0	0	0	0	0	0	0	0	1	0.1
Grounding	2	3	2	1	0	1	1	0	0	0	10	1
Leaks/Swamping	1	3	0	1	0	0	0	0	0	0	5	0.5
Other nautical safety	8	0	7	5	16	12	20	20	17	14	119	11.9
Person in distress	3	5	2	2	2	7	2	0	4	4	31	3.1
Persons in the water	1	1	9	0	1	1	1	0	5	1	20	2
Grand Total	**20**	**21**	**31**	**19**	**23**	**29**	**27**	**25**	**34**	**22**	**251**	**25.1**

Table 4 presents RNLI national dataset incidents and their locations are displayed at Figure 11. It shows there were 251 incidents recorded in the 10-year period within the study area. For the RNLI dataset, the most frequent type of incident was 'Other nautical safety' with 119 incidents and making up 47.4% of the total incidents. While there are a number of these incidents spread across the study area it can be seen in Figure 11, that there is a large majority which occur within the vicinity of the inner harbour.

Table 5. FDEC Marine incident summary for the study area (2013 to 2024)

Incident Category	Year											Annual Frequency
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total	
Equipment Failure (vessel)	0	0	1	0	0	0	1	0	0	0	2	0.2
Grounding	0	0	1	0	0	0	0	0	0	0	1	0.1
Heaving Line	0	0	0	1	0	0	0	0	0	0	1	0.1
Impact with Structure	2	0	0	0	0	0	0	0	0	0	2	0.2
Jetsam/ Flotsam	0	0	0	0	0	0	0	0	0	1	1	0.1
Other Nautical Safety	0	2	1	2	0	0	0	2	1	1	9	0.9
Ranging	0	0	0	0	0	0	0	0	0	1	1	0.1
Grand Total	**2**	**2**	**3**	**3**	**0**	**0**	**1**	**2**	**1**	**3**	**17**	**1.7**

Table 5 presents FDEC's local dataset of incidents and their locations are displayed in Figure 12. It shows there were 17 incidents recorded in the 10-year period within the study area. For the FDEC dataset, the most frequent type of incident was 'Other nautical safety' with nine incidents. The second most common incident type is 'Equipment Failure (vessel)' and 'Impact with Structure ' both with two incidents.

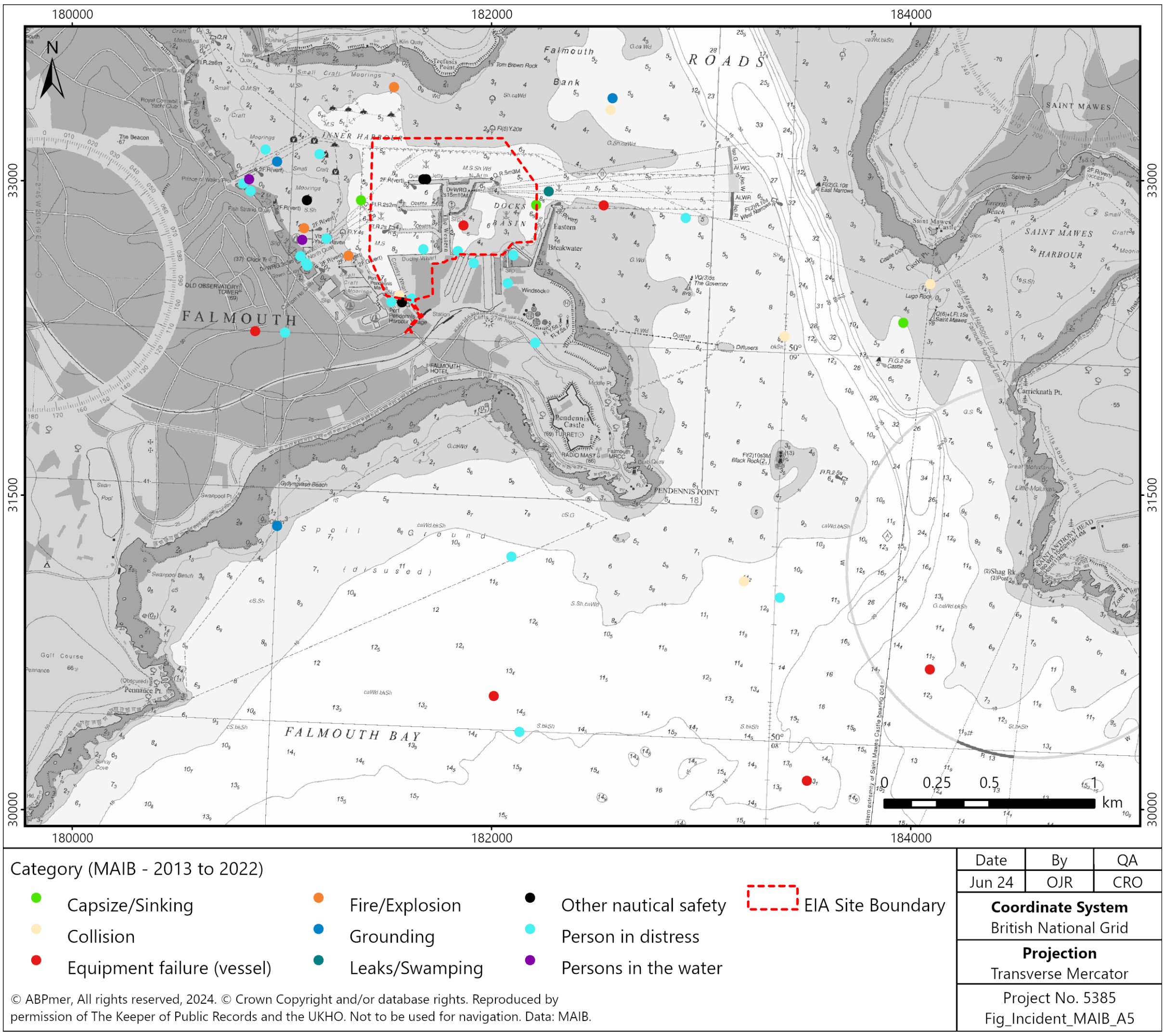
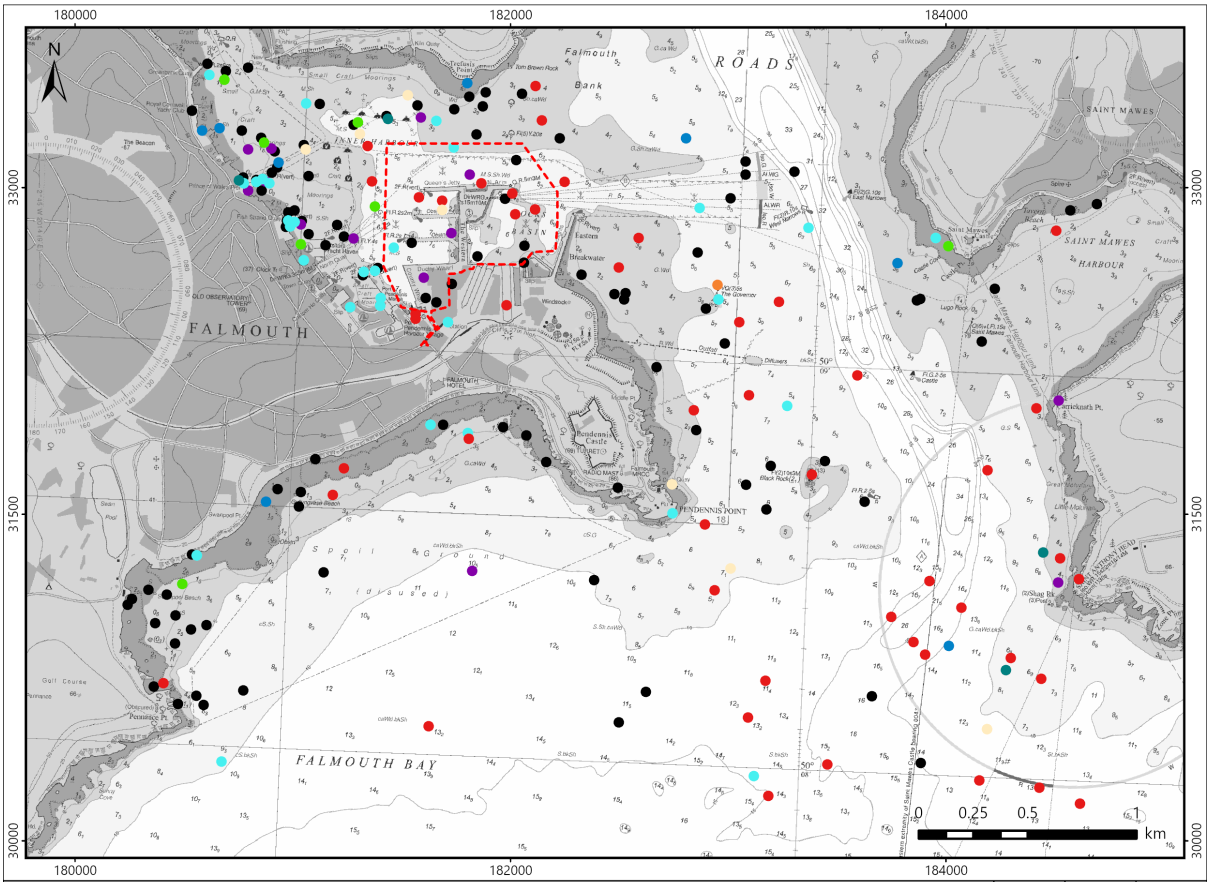


Figure 10. Maritime Accident and Investigation Branch Accidents/Incidents



Category (RNLI - 2013 to 2022)

- Capsize/Sinking
- Collision
- Equipment failure (vessel)
- Fire/Explosion
- Grounding
- Leaks/Swamping
- Other nautical safety
- Person in distress
- Persons in the water
- EIA Site Boundary

Date	By	QA
Jun 24	OJR	CRO

Coordinate System
British National Grid

Projection
Transverse Mercator

Project No. 5385
Fig_Incident_RNLI_A5

Figure 11. Royal National Lifeboat Institution Accidents/Incidents

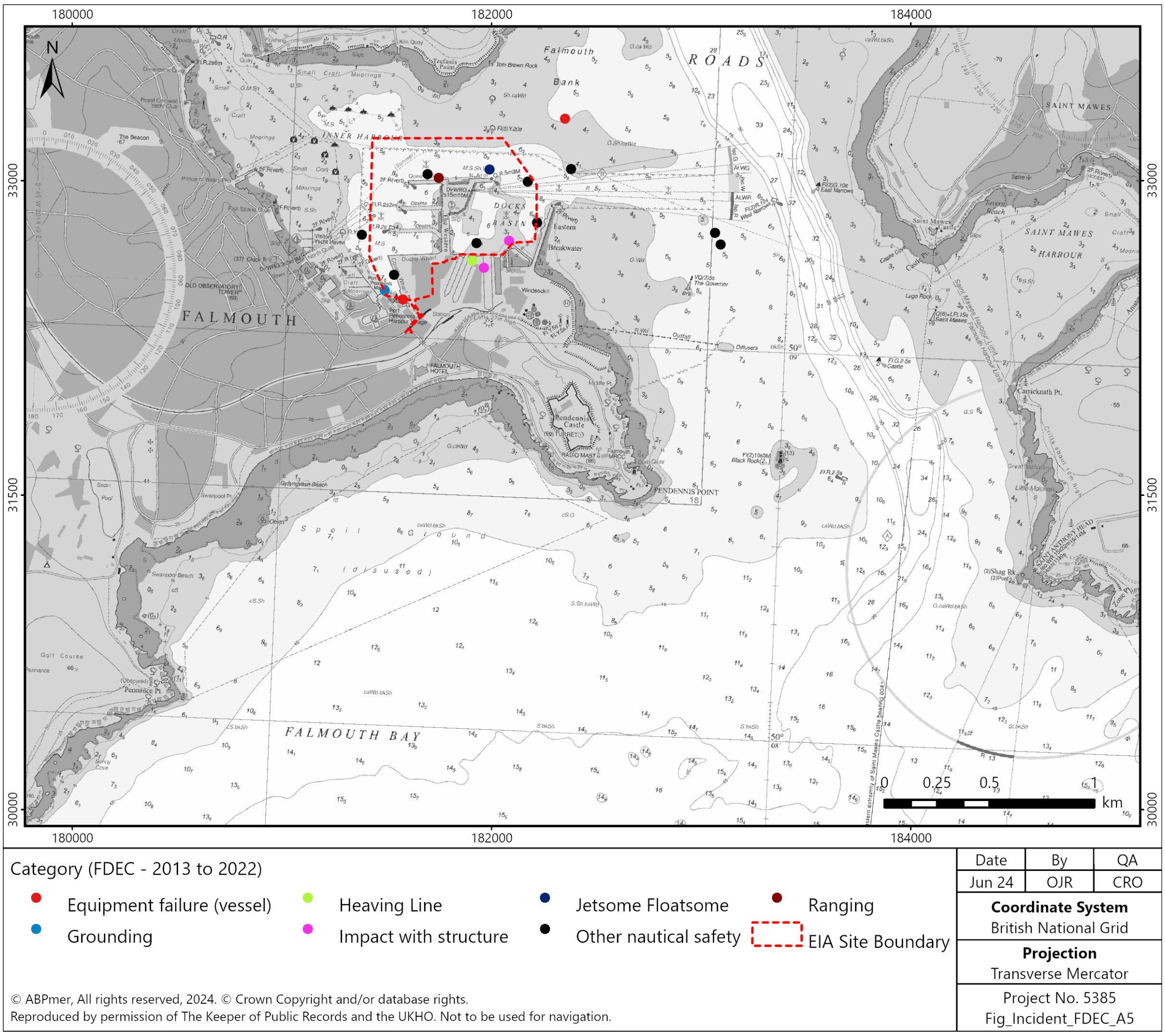


Figure 12. Falmouth Docks and Engineering Company Accidents/Incidents

3 Proposed Development Details

3.1 Construction

It is anticipated that the demolition and construction programme would be delivered in five phases. Strengthening, enabling dredging and demolition works would be undertaken in the first instance. Following this, construction of wharf structures would be undertaken as outlined. The indicative phasing would comprise:

- Phase 1: Strengthening and enabling works;
- Phase 2: Dredging and demolition;
- Phase 3: Western Wharf and Northern Wharf;
- Phase 4: Queens Wharf Extension; and
- Phase 5: Duchy Wharf and FLOW deck.

For further detail, refer to ES Chapter 5 Demolition and Construction.

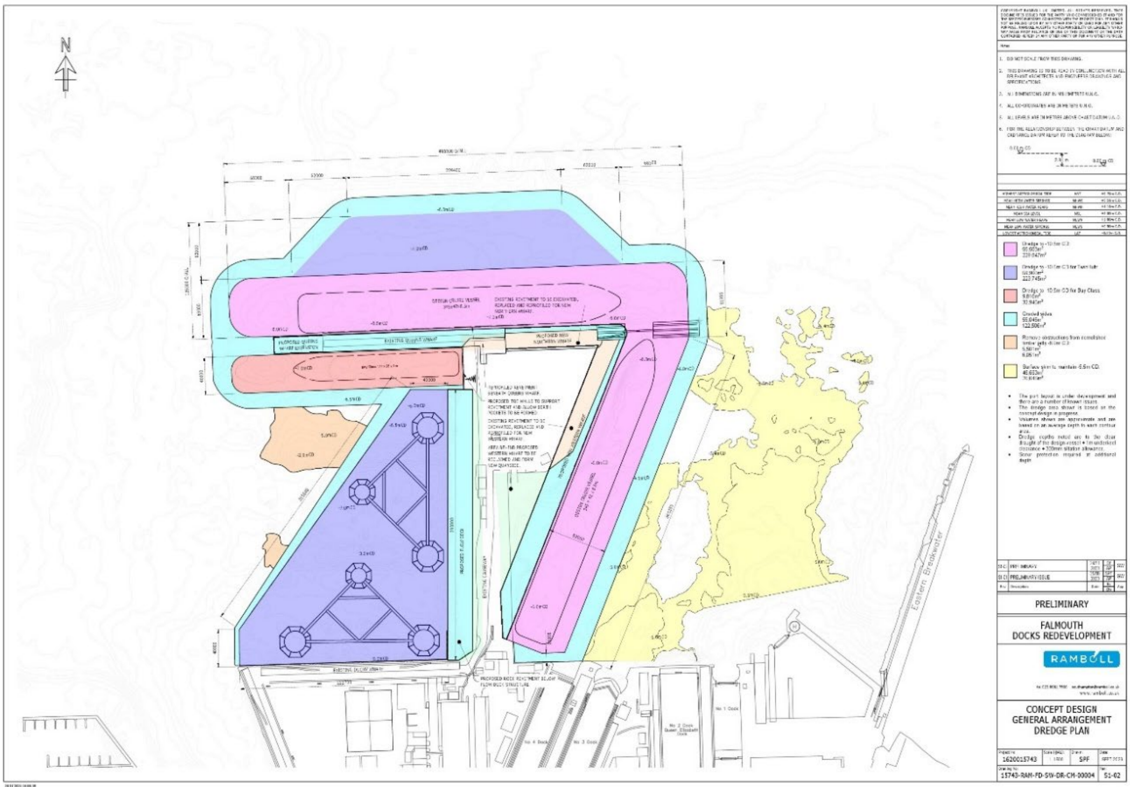
3.1.1 Survey

The site will require several surveys to ascertain dredge levels and identify any potential obstructions that could hinder the dredging process. Pre and post dredge surveys determine dredge levels at the berth pockets and potential obstructions around the proposed development. The post-construction survey will check the dredged area profile and provide an opportunity to identify any obstructions associated with the constructions works that may present a risk to navigation.

3.1.2 Dredging

Dredging activities are central to the construction stage. A capital dredge will create berth pockets to accommodate new vessel sizes. The dredging methodology is designed to minimise environmental impact and sediment mobilisation and is detailed in the EIA (see ES Chapter 5 Demolition and Construction). The capital dredge material will be transported via barge to an approved disposal location in Falmouth Bay if contaminant test results permit this. Certain dredged materials, particularly those consisting of denser material, will be evaluated for its suitability for reuse within the project works.

The dredge plan in Figure 13 identifies the berth pockets along the Western Wharf, north and south of Queen's Wharf and in the western basin adjacent to the proposed FLOW Deck. These pockets have a proposed depth of -10.5 m below Admiralty Chart Datum (ACD). In addition to the deeper berth pockets, it is proposed that any obstructions to navigation are removed from the eastern side of the causeway to -5.5 m ACD. It is anticipated that use of backhoe dredger will be employed to excavate the berth pockets. This NRA has been written based on the backhoe dredger, working to barges, as the principal dredge method during the construction stage.



Source: Ramboll UK, 2024a

Figure 13. Dredge Plan

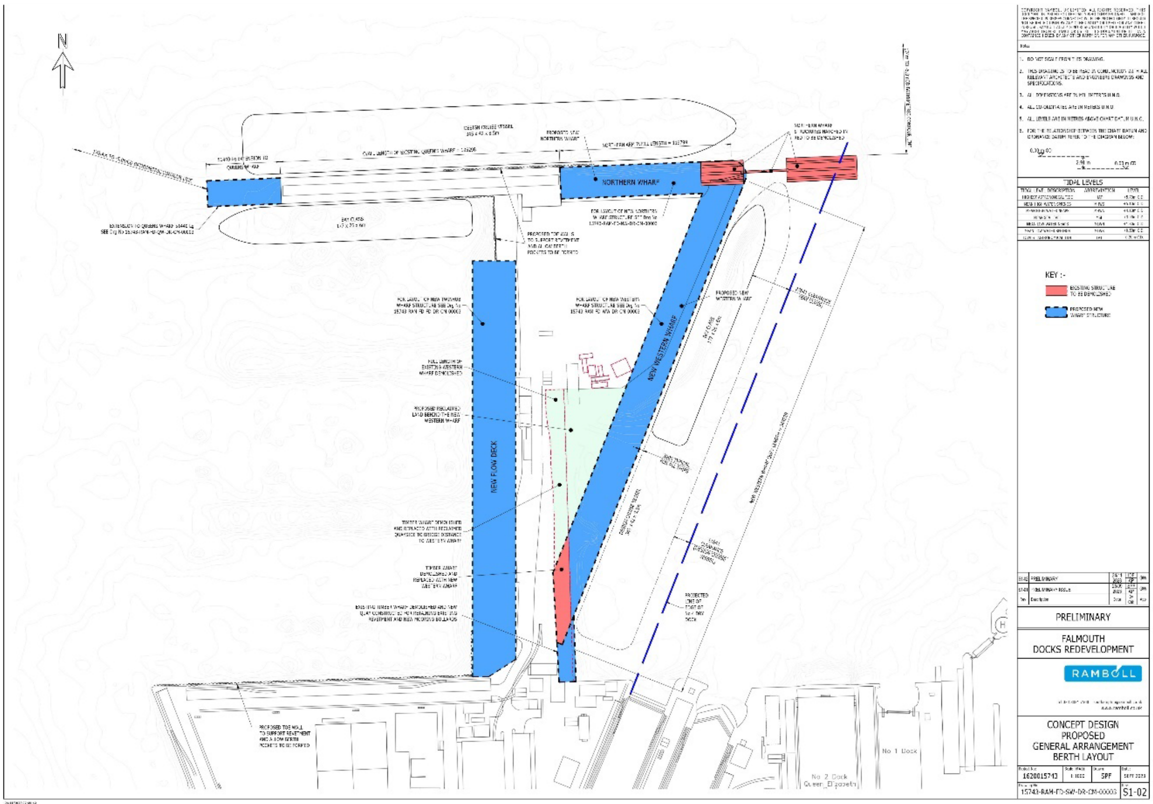
3.1.3 Demolition of existing infrastructure

Figure 14 identifies the areas of the existing port which are to be demolished during the construction stage; these are identified as red in the figure. The Northern Arm in the top right corner consists of a dolphin which partially obstructs line of sight to and from the berth and the Western Wharf identified as the red section towards the bottom of Figure 14. The demolition of these sections of existing infrastructure is to take place following the majority of the construction of new infrastructure and will involve the removal of the wooden infrastructure which currently is a risk to navigating vessels due to semi-submerged piles that have come loose. Further detail is included in the EIA (refer to ES Chapters 4 and 5).

3.1.4 Construction of suspended deck structures

The proposed development incorporates new suspended deck structures such as the Queen's Wharf Extension, Western Wharf, Northern Wharf, and FLOW Deck shown in Figure 14 (blue sections). These structures are supported by a combination of vertical and raking piles, providing the necessary foundation over the existing revetment with a reinforced concrete deck over the top. The Western Wharf includes an area of land reclamation in between the new Western Wharf and existing causeway (shown in green in Figure 14). The construction of these decks employs precast concrete elements, minimising the need for marine plant and contributing to a safer construction environment over water.

Piled toe walls are crucial for retaining the existing revetments beneath Duchy Wharf and the existing eastern section of Queen's Wharf. This work allows for the strengthening of the structure in areas where dredging activities might undermine the structure's base. Depending on the rock conditions, either driven sheet piles or bored secant walls will be used. Further detail is included in the EIA (refer to ES Chapter 4).



Source: Ramboll UK, 2024b

Figure 14. Plan of proposed works

3.1.5 Construction vessels and equipment

A fleet of specialized vessels is proposed to support the maritime aspects of the construction. This includes spud leg barges for dredging activities, backhoe dredger vessels for precision excavation, and barges (both towed and self-propelled) for removing dredge material. Additionally, material delivery vessels or barges are likely to transport piles, precast elements, and rock armour by sea.

3.2 Operation

Operation of the proposed development would continue to accommodate existing activities and industries as well as those introduced through the proposed development, which comprise:

- Cargo – glass recycling, granite, bulk cement, road salt, other bulk products, and project cargo;
- Cruise – off-boarding and on-boarding of daily cruise vessels;
- FLOW – construction and maintenance of FLOW devices;
- Ship Repair- Berthing capacity for ship repair vessels; and
- Other – Ships that use the site but are not a main function of the operations and include irregular and inconsistent movements.

Due to the nature of the proposed development as an operational docks there is a need for flexibility within day to day operations. Numerous vessel types, berth at Falmouth Docks for varying lengths of time. The vessels that would frequent Falmouth Docks include, but are not limited to:

- Cargo Vessels:
  - Vessels typically berth for short periods of time and are approximately 60 – 100 m in length and approximately 7 m in height[1].
  - Vessels are crewed at all times and are lit at night;
- Military Vessels:
  - Berth period for vessels is dependent on specific work packages and varies. A typical timeframe would be three – six months;
  - Vessels are approximately up to 180 m in length and approximately 33 m in height[1];
  - Vessels are crewed at all times and are lit at night;
- Ship Repair Vessels:
  - Typically comprise vessels that have come from the dry docks.
  - Vessels berth for short periods of time and can be up to approximately 260 m in length, with typical vessels from 80 m to 160 m in length and approximately 39 m in height[1];
- Cruise Vessels:
  - Vessels typically berth for short periods of time and can be up to approximately 345 m in length, with typical vessels from 200 m to 275 m in length, and approximately 70 m in height[1]; and
  - Vessels are crewed at all times and are lit.

In addition to the above vessels, many other vessels berth at Falmouth Docks. These vessels include, but are not limited to: GI rigs, survey vessels, tug boats, subsea-support vessels, ferries, accommodation vessels, tankers, dredgers, gas carriers and car carriers.

1 Vessel heights calculated above mean water line, are indicative and will vary depending on the tide.

3.3 Future traffic baseline

The proposed development will improve the current navigational situation at Falmouth Docks and will alter traffic patterns in the immediate locality to the works. The following sections expand on the future traffic baseline, highlighting changes to traffic types.

3.3.1 Cruise traffic

The projected cruise and passenger numbers for 2024 reflect the increase in excellence class vessels visiting Falmouth.

The proposed development will increase cruise capacity at Falmouth Docks to accommodate up to 120,000 passengers per year and would accommodate excellence class cruise vessels within the docks (allowing these vessels to berth), which would comprise approximately 6,000 passengers per ship. Based on the existing data, the projected capacity at Falmouth Port has been calculated for the completed development (2027). As the 2027 cruise schedule is currently unknown, the following approach and resulting assumptions have been derived to enable assessment and a conservative approach has been adopted:

- To accommodate the increase in passengers of up to 120,000 people, it is assumed that 11 additional excellence class vessels would be required per year.
- The increase in berth capacity as a result of the proposed development is anticipated to reduce the number of tender calls as the port could accommodate larger cruise ships alongside.

3.3.2 Cargo and Commercial Operations

The proposed development would continue the existing cargo operations with sufficient landside space, capacity and facilities that would be prioritised for cargo operations while not disrupting the other essential port operations. However, all berths would be suitable for cargo operations. There is the potential for cargo to increase from approximately 12 cargo vessels per year to approximately 24 cargo vessels per year by 2027, dependent on market conditions.

In 2019, 152,000 freight tonnage flowed through Falmouth (both directions), down from a high of 753,000 tonnes in 2007. This drop in cargo volumes seen over the last decade is partly explained by the fact that the peak values seen in 2006-2008 reflect a considerable amount of 'bunkering' e.g., of oil and other products, which utilised the facilities at Falmouth Harbour at that time, this has since dropped off. Falmouth represents only a small proportion of the overall UK freight market – less than 0.1% of freight volume flowed through Falmouth in 2019. The market tends to be dominated by the major ports such as London Gateway, Grimsby & Immingham, Southampton, and Felixstowe.

The site is an important export site for glass recycling collected from the wider county of Cornwall. These cargo operations often require large amounts of landside deck space to operate from. The safe loading of cargo requires approximately 18 m deck width for gangway, loading and crew to load the glass cargo onto the vessel safely. The existing site is unable to meet the export targets for this glass under current berth conditions and due to the use of wharfs by other vessels, such as RFA vessels, for extended periods of time.

The site is also a significant export location for local granite quarried from surrounding areas; the quarry is understood to have long-term planning permission in place and so this demand is not anticipated to reduce in the future.

These cargo operations often require significant amounts of landside deck space to operate from, including sufficient loading capacity of these areas. The current loading capacity of the wharves is restricted and therefore limits the availability for certain cargo vessels which require a minimum tonnage specification in order to unload heavy project cargos.

Existing business at wider Falmouth Docks site, including essential ship repair, would be maintained. The ship repair industry is a critical service that the wider Falmouth Docks site is able to provide with the dedicated dry dock facilities located to the south-east of the site redline boundary. The proposed development would continue to provide berthing space for shir repair vessels. A&P's Falmouth facility is the largest ship-repair complex in the UK. Ship repair activities would not be impacted by the proposed development.

3.3.3 Military Operations

Falmouth Docks facilitates Ministry of Defence (MoD) vessels for the majority of the year. There is an MoD contract in place for RFA vessels to use Falmouth, these RFA vessels are understood to berth at the site for prolonged time periods which results in limited berth capacity for other vessels. The proposed development would resolve such conflicts.

The site also serves other essential functions for the county and southwest, for example it is a port of refuge and provides berths for port tugs. The site also hosts international public events such as Falmouth Tall Ships and the Armed Forces Day. These activities would not be impacted by proposed development.

3.3.4 Flow Operations

In 2020, the UK government increased the 2030 offshore wind target set by the Offshore Wind Sector Deal from 30 gigawatts (GW) to 40 GW, with at least 1 GW coming from FLOW. Allocation Round 4 consent has been given to a FLOW developer, with a possible assembly and maintenance base at Falmouth due to its location and facilities. Demand for FLOW and dock infrastructure is only considered to increase in the future to support net zero targets.

The site is considered to be a prime location for renewable floating offshore wind (FLOW) due to its proximity to the Celtic Sea and other offshore wind sites such as Hayle which are within the 72-hour weather forecasting window required for FLOW and towing distances. The site is well suited to serve as a base for FLOW operation and maintenance services; vessels that support offshore wind development are understood to use the existing site.

The proposed development would support FLOW and make use of the site's location in proximity to the WaveHub site off the coast of Hayle, Cornwall, which is to be used to install the first floating offshore wind technology into the Celtic Sea. Upgrades to dock infrastructure would be required to support the operation and maintenance of FLOW devices.

The proposed development would therefore meet the needs of the FLOW devices, which are large and require significant quayside areas with good mooring loading capability. Duchy Wharf and the FLOW Deck are proposed to be used for the assembly of FLOW turbines. Duchy Wharf and the FLOW Deck would facilitate the crane movements required to assemble the FLOW devices and to avoid clashes with vessels and other operations.

Tugboats would pull FLOW devices into the site's western basin. The proposed development would have capacity for two FLOW devices, which would berth alongside Duchy Wharf and the FLOW Deck, respectively. Each device would be able to support two wind turbines. FLOW turbines and towers would be lifted from their stored position on the land behind Duchy Wharf using a mobile crane. Supporting plant and limited materials are to be stored on Duchy Wharf.

The following assumptions have been adopted in respect of the FLOW programme:

- At any one time, there would only be one fully integrated FLOW device (two turbines), with a second FLOW device base alongside the FLOW Deck awaiting integration on the Duchy Wharf.
- It is anticipated that once a FLOW device is fully integrated it would be towed out to sea.
- It is assumed that a fully integrated FLOW Device would remain in the dock for up to two weeks.
- Once a fully integrated FLOW device is deployed at sea, return to Falmouth Docks would only occur if and the FLOW device required significant repairs that were unable to be conducted at sea; all required repair equipment is available. The FLOW device would not occupy a berth if not being actively repaired due to requirements and commitments to other operations.

3.3.5 Navigation

Following construction, as a result of berth extension, land reclamation, dredging and the removal of the North Wharf Dolphin vessel routeing for commercial vessels may differ depending on berth allocation of the newly developed area, however there is minimal anticipated change to vessel transits in general. Recreational users of the harbour will need to adjust to the 50 m extension to the west and establish new 'headmarks' to accommodate the change in navigable environment, this is not anticipated to alter local use as recreational users typically avoid navigation in close proximity to Falmouth Docks, given its commercial nature and use by larger commercial vessels.

3.4 Additional considerations

As discussed in section 3.3.3 the proposed development identifies the potential to use the site for FLOW related activities. Whilst the potential establishment of a FLOW launching site at FDEC will require its own specific and detailed considerations, FLOW activities have been assessed at concept level. Given the experience of Falmouth Docks in handling maritime traffic, potential risks of marine incidents (for example, grounding, collisions, or impacts) involving wind turbine components and other vessels can be minimised through careful specific passage plans and risk assessments. This NRA has assessed the operational risk of irregular, abnormal and novel tows which also includes FLOW considerations.

Once FLOW activities are defined further, more detailed examination may be necessary such as simulation studies and weather-related assessments. This will include a review of towage into, and out of Falmouth Docks and may also include simulation of irregular and novel tows. The existing FDEC MSMS includes planning and mitigation strategies for non-routine towage procedures which currently manages the risks associated with irregular and novel tows. Any irregular, abnormal and novel tows through FHC's harbour area will be subject to a review and approvals process that includes all parties contributing to marine safety, including relevant SHAs, the Pilots and towage providers.

4 NRA Method

4.1 Introduction

This NRA has been undertaken to determine the navigational risk associated with the construction and operation of the proposed development. Specifically, those risks which are not already present within the context of the normal port operations and considerations within FDEC's MSMS. The methodology applied for conducting this NRA follows the guidance from the Port Marine Safety Code's Guide to Good Practice (DfT, 2018). The following identifies the stages used in the process:

1. Identification of hazard (listing of potential marine hazard scenarios, describing hazard descriptions and outcomes).
2. Risk analysis (determination of likelihood and consequence for each hazard scenario).
3. Risk assessment and control options (consideration of existing (embedded) mitigation measures, which either reduce the outcome likelihood 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. Tolerability and ALARP (determining if the hazards identified fit with the organisation's tolerance for risk and if they are ALARP with further controls identified).

The following sections identify the outcome from the above steps. Section 6 describes and expands on the discussion of the Hazard Logs (Appendices A and B) which form the interpretation of this NRA.

4.2 Hazard identification

When considering the introduction of new port infrastructure or alterations to existing 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.

Within the process of hazard identification and risk analysis, contributions have been included from a range of stakeholders including Senior FDEC personnel, FDEC's Designated Person, FDEC Marine Managers and Dockmaster, Falmouth Pilots, representatives of the project team from Ramboll UK and key port users.

4.3 Risk analysis

Figure 15 identifies the discussion flow per hazard scenario. The attendees contributed to the formation of the hazard scenarios with descriptive 'worst credible' (WC) and 'most likely' (ML) events assessed against four consequence receptors drawn from the PMSC's GtGP (DfT, 2018), namely:

- People;
- Property;
- Planet; and
- Port (reputation).

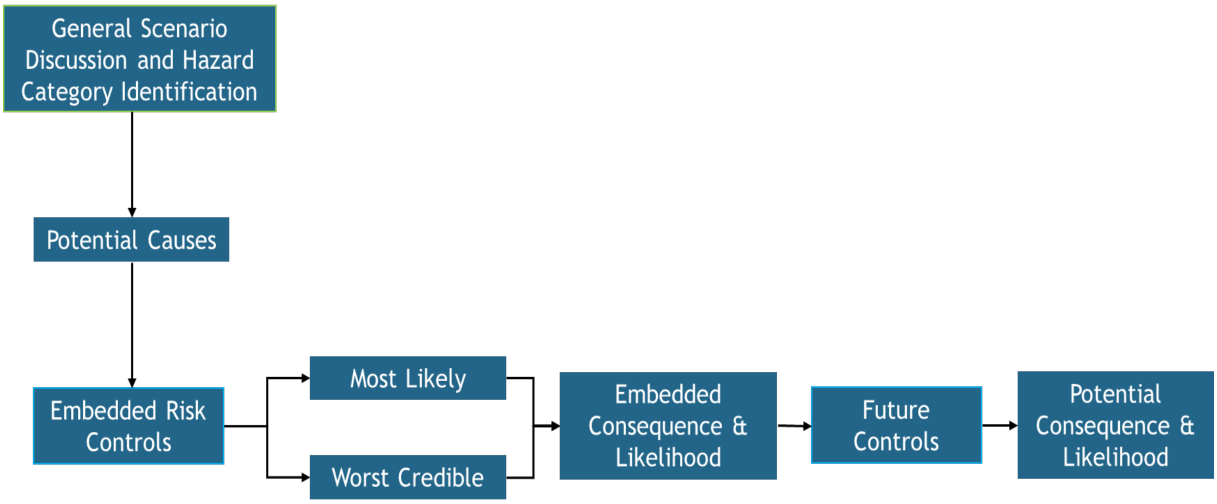


Figure 15. Workshop Discussion Flow Chart

Risk analysis for the WC and ML outcomes with existing control measures in place were then conducted. The consequence descriptors for each category are shown in Table 6 and the descriptors for likelihood in Table 7.

4.3.1 Consequence descriptors

The consequence descriptors, as used by FDEC from their existing MSMS and associated risk assessments have been used to inform the assignment of values to the hazard scenarios. The outcome is displayed in the Hazard Log.

Table 6. Consequence Descriptors

Descriptor	Category	#
Consequence Descriptors: People		
No injury	Negligible	0
Minor injury(s)	Minor	1
Serious injury(s) (MAIB/RIDDOR reportable injury)	Moderate	2
Single fatality	Major	3
Multiple fatalities	Extreme	4
Consequence Descriptors: Property (Assets)		
Negligible (£0 - £2,000)	Negligible	0
Minor (£2,000 - £10,000)	Minor	1
Moderate (£10,000 - £100,000)	Moderate	2
Serious (£100,000 - £1m)	Major	3
Major (> £1 million)	Extreme	4
Consequence Descriptors: Planet		
No Impact	Negligible	0
No Measurable Impact (An incident or event occurred, but no discernible environmental impact - Tier 1 but no pollution control measures needed)	Minor	1
Minor (An incident that results in pollution with limited/local impact - Tier 1, Harbour Authority pollution controls measures deployed)	Moderate	2
Significant (Has the potential to cause significant damage and impact - Tier 2, pollution control measures from external organisations required)	Major	3
Major (Has the potential to cause catastrophic and/or widespread damage - Tier 3, requires major external assistance)	Extreme	4
Consequence Descriptors: Port Reputation		
None	Negligible	0
Minor (Little local publicity. Minor damage to reputation. Minor loss of revenue, £0 - £2,000)	Minor	1
Moderate (Negative local publicity. Moderate damage to reputation. Moderate loss of revenue, £2,000 - £10,000)	Moderate	2
Serious (Negative national publicity. Serious damage to reputation. Serious loss of revenue, £100,000 - £1m)	Major	3
Major (Negative national and international publicity. Major damage to reputation. Major loss of revenue, > £1 million)	Extreme	4

4.3.2 Likelihood descriptors

The likelihood descriptors are used to inform the assignment of likelihood values to the hazard scenarios within the Hazard Log. The descriptors are detailed in Table 7.

Table 7. Likelihood Descriptors

Years	Likelihood	#
1 : 50 years	Very Unlikely	1
1 : 25 years	Unlikely	2
1 : 10 years	Occasionally	3
1 : 5 years	Probable	4
>1 : year	Likely	5

4.4 Risk assessment and control options

Following the Hazard Identification and Risk Analysis workshop, the next step considers Risk Assessment and control options. Risk Assessment includes a review of existing (embedded) controls as well as future additional controls identified (additional). This step allows a broader view of controls, some of which may not have been considered at each of the HAZID and Risk Analysis workshop. It is likely that future additional controls are identified, which if applied could further reduce the outcome.

In doing so there is a hierarchy of risk control principles as advised in the GtGP. 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 each hazard scenario's risk outcome. The overall risk exposure of the organisation is considered during this stage with future additional controls needing consideration as to whether they reduce the risk to a tolerable and ALARP state.

4.5 Tolerability and ALARP

The aim of conducting risk assessments for marine operations in harbours is to ensure that risk outcomes are reduced to a tolerable and ALARP state to the satisfaction of the organisation that is ultimately accountable. 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"*

An organisation that requires an NRA needs to define its position on tolerability. Without this known state of risk acceptability, hazard scenarios (and their associated risk outcomes) cannot be determined as tolerable or intolerable. 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"*

Tolerability is considered in the context of likelihood and consequence descriptors specific to each of the 4 previously mentioned receptors.

Table 8. Tolerability Key

Tolerability Key	
Intolerable	(red)
Tolerable (Borderline/ Limit)	(yellow)
Tolerable	(green)

Table 9. Tolerability – People

		People				
Consequence	Multiple Fatalities					
	Single Fatality					
	Serious injury(s) (MAIB/RIDDOR reportable injury)					
	Minor injury(s)					
	No injury					
		1 in 50 years	1 in 25 years	1 in 10 years	1 in 5 years	Yearly or more frequent
		Likelihood				

Table 10. Tolerability – Property

		Property				
Consequence	Major (> £1 million)					
	Serious (£100,000 - £1m)					
	Moderate (£10,000 - £100,000)					
	Minor (£2,000 - £10,000)					
	Negligible (£0 - £2,000)					
		1 in 50 years	1 in 25 years	1 in 10 years	1 in 5 years	Yearly or more frequent
		Likelihood				

Table 11. Tolerability – Planet

	Planet					
Consequence	Major (Tier 3, requires major external assistance)					
	Significant (Tier 2, pollution control measures from external organisations required)					
	Minor (Tier 1, Harbour Authority pollution controls measures deployed)					
	No Measurable Impact (Tier 1 but no pollution control measures needed)					
	None (No incident - or a potential incident/near miss)					
		1 in 50 years	1 in 25 years	1 in 10 years	1 in 5 years	Yearly or more frequent
		Likelihood				

Table 12. Tolerability – Port Business/ Reputation

	Port Business/ Reputation					
Consequence	Negative national and international publicity. Major damage to reputation.					
	Negative national publicity. Serious damage to reputation.					
	Negative local publicity. Moderate damage to reputation.					
	Little local publicity. Minor damage to reputation.					
	None					
		1 in 50 years	1 in 25 years	1 in 10 years	1 in 5 years	Yearly or more frequent
		Likelihood				

5 HAZID and Risk Analysis Workshop

A HAZID and Risk Analysis workshop with relevant stakeholders was held on 11 January 2024. The overall aim of the workshop was to identify the navigational hazards potentially introduced by the proposed development to inform the assessment and resultant risks. A qualitative approach was taken during the workshop with stakeholders who provided the requisite subject matter expertise. This included a review of navigation baseline data and anecdotal information regarding marine use within the study area.

Following discussion of the identified hazards, their causes and embedded controls, additional control measures were then discussed with a view to informing the reduction of any risks associated with the proposed development to an ALARP state. The attendees and people consulted for the hazard identification and risk analysis workshop are shown in Table 13.

Table 13. Hazard Identification and Risk Analysis workshop attendees

Attendee	Organisation
HAZID and Risk Analysis Workshop: 11 January 2024	
Drystan Jones	Director Port Development – FDEC
Luke Wills	Marine Operations Manager – FDEC
Tim Sykes	Marine Operations Manager – FDEC
Kevin Peart	Designated Person – FDEC
Mike Pereir	Environmental Manager – FDEC
Paul Denmead	Operations Manager – World Fuel Services
Julia Thompson	Principal Environmental Consultant – Ramboll UK
Aaron Parry	Principal Engineer – Ramboll UK
Graeme Walker	Associate, Marine – Ramboll UK
Tristan Gurd	Pilot – Falmouth Harbour Pilots
Tom Redgrave	Marine Manager/ Pilot – Falmouth Harbour Commissioners
Mike Webb	Port Pendennis

During the HAZID and risk analysis workshop a recording rationale of the 'on-balance most risk averse position' as provided by the stakeholders to help reach consensus. Where two or more stakeholders had disagreement on a risk level, the higher of the two positions was taken if they were adjacent. Alternatively, if the two differing positions were separated then the middle was taken. For example, if 'Likely' and 'Unlikely' were provided as responses, an outcome of 'Possible' was recorded. If a position of 'Likely' and 'Possible' was returned, then the outcome was recorded as 'Likely'.

Following the workshop, a correspondence review period provided the stakeholders with the opportunity to comment on the hazard scenarios that had been identified and put forward any scenarios that had not been addressed. All feedback was included into the Hazard Log (Appendices A and B) as part of the risk analysis process.

6 Hazard Scenarios

6.1 Introduction

Prior to the HAZID and Risk Analysis Workshop a series of potential hazard scenarios were circulated for discussion. Stakeholders had the option to review the identified hazard scenarios and propose further hazard scenarios during this time. The following section identifies the hazard scenarios identified from the hazard identification process that, as a result of the proposed development, raise risks that are additional and separate to the ordinary operation of the docks.

6.2 Hazard categories

Prior to the HAZID and Risk Analysis workshop a comprehensive list of hazard categories was sent to the prospective attendees. From this list six hazard categories were identified for this risk assessment and are detailed in Table 14 along with descriptions relating to them. These hazard categories were also made available in the HAZID and Risk Analysis Workshop for attendee reference.

Table 14. Hazard Categories

Hazard Category	Descriptors
Accidents to Personnel	Accidents to personnel are defined as those accidents which cause harm to any person on board the vessel e.g. crew, passengers, stevedores; which do not arise as a result of one of the other accident categories. Essentially, it refers to accidents to individuals, though this does not preclude multiple human casualties as a result of the same hazard, and typically includes harm caused by the movement of the vessel when underway, slips, trips, falls, electrocution and confined space accidents, food poisoning incidents, etc.
Allision	Defined as a violent contact between a vessel and a fixed structure.
Contact	Contact is defined as a vessel striking, or being struck, by an external object that is not another vessel or the sea bottom. Sometimes referred to as Impact.
Collision	Collision is defined as a vessel striking, or being struck, by another vessel, regardless of whether either vessel is under way, anchored or moored; but excludes hitting underwater wrecks.
Stranding/Grounding	Grounding is defined as the ship coming to rest on, or riding across underwater features or objects, but where the vessel can be freed from the obstruction by lightening and/or assistance from another vessel (e.g. tug) or by floating off on the next tide. Stranding is defined as being a greater hazard than grounding and is defined as the ship becoming fixed on an underwater feature or object such that the vessel cannot readily be moved by lightening, floating off or with assistance from other vessels (e.g. tugs).
Payload Related Accidents	Payload related accidents include loss of stability due to cargo shifting and damage to the vessel's structure resulting from the method employed for loading or discharging the cargo. This category does not include incidents which can be categorised as Hazardous Substance, Fires, Explosions, Loss of Hull Integrity, Flooding accidents etc.

6.3 Hazard scenarios

The hazard scenarios identified below in Table 15 to Table 16 have each been considered. This provides the option to consider very serious outcomes which could credibly occur (i.e., WC), together with outcomes that are potentially less serious but could occur on a more frequent basis (i.e., ML) to consider a hazard category more completely. Complete detail, descriptions, and evaluations for each hazard scenario are presented as a Hazard Log, in table format, in Appendices A & B for construction and operation, respectively.

Table 15. Demolition and Construction Hazards

ID	Category	Hazard Scenario
C1	Collision	Small leisure vessel collides with barge
C2	Collision	Large (>100 m) commercial vessel collides with construction vessel
C3	Collision	Commercial (24-99 m) vessel collides with construction vessel
C4	Accidents to personnel	Man overboard during dredge / construction works
C5	Accidents to personnel	Diving Operations associated with installation of cathodic protection
C6	Stranding/ Grounding	Construction Craft / Backhoe Dredger grounds whilst conducting works
C7	Collision	Backhoe Dredger / Dumb Barge & Tow / Self-propelled Construction Craft with another vessel
C8	Allision	Backhoe Dredger / Construction craft has an allision with port infrastructure
C9	Stranding/ Grounding	Commercial vessel delivering construction components grounds during transit into harbour
C10	Collision	Commercial vessel delivering construction components has a collision with another vessel during transit into harbour
C11	Allision/ Contact	Commercial vessel delivering construction components has an allision with port infrastructure on approach
C12	Payload Related Incident	Spud leg barge / Dumb barge and tow / Self-propelled Construction Craft have payload related incident

Table 16. Operation Hazards

ID	Hazard Category	Hazard Scenario
O1	Allision/ Contact	Large cruise vessel (250-350 m) contact with port infrastructure
O2	Allision/ Contact	Allision between a commercial vessel and Queen's Wharf extension
O3	Collision	Vessel leaving drydock makes contact with moored cruise vessel
O4	Allision/ Contact	Allision between Dead Tow / abnormal indivisible load (inc. FLOW) and port infrastructure / contact with berthed vessel
O5	Other (Towage Breakout)	Dead Tow / abnormal indivisible load (inc. FLOW) breaks free from its tow
O6	Collision	Dead Tow / abnormal indivisible load (inc. FLOW) breaks free from its tow
O7	Stranding/ Grounding	Dead Tow / abnormal indivisible load (inc. FLOW) grounds during transit between FDEC and sea

7 NRA Discussion

7.1 Introduction

This section provides a commentary on the navigational risk assessments contained within the Hazard Logs provided in Appendices A and B.

The Hazard scenarios analysed at the HAZID and Risk Analysis Workshop were thoroughly discussed by the stakeholders, while those assessed by ABPmer in addition have been assessed in full consideration of the data drawn from the HAZID and Risk Analysis workshop. The causes and embedded controls were identified, and from these the perceived embedded risk outcomes were determined. Subsequently, the potential future controls were discussed and their effect upon the hazard scenario was analysed for both the WC and ML scenarios. Following this those assessing the hazard scenarios assessed what the potential risk outcome may be if the future additional controls discussed were applied. .

7.2 Hazard scenario causes

1.1.1 The possible causes leading to each of the identified hazard scenarios have been considered as part of the risk assessment process. Table 17 and

Table 18 present a compiled list of causes from the hazard scenarios and the occurrence count across the 12 demolition and construction risks and 4 operation risks assessed, respectively. These causes, and the hazards to which they apply can be found in the risk assessments contained within the Hazard Logs provided at Appendices A and B.

Table 17. Hazard Scenario Causes – Demolition and Construction

Causes	Count (max 12)
Human error	10
Adverse weather	7
Equipment failure	7
Miscommunication	6
Lack of situational awareness	6
Failure to adhere to COLREGs	5
Fatigue	4
Restricted/ Poor visibility	4
Traffic management error – Port planning	4
Communication failure	3
Misjudged manoeuvre	3
Inaccurate charting	2
Lapse in survey and maintenance dredging programme	2
Inadequate procedures shoreside	2
Failure to comply with safe systems of work	2
Incorrect assessment of height of tide	2
Damage to construction critical cargo	2
Flag ‘A’ not flying/ observed	1
Interaction with recreational/ fishing craft	1

Causes	Count (max 12)
Excessive load	1
Unbalanced load	1
Excessive vessel speed	1
Foul ground obstructions	1
Inadequate procedures in place onboard vessel	1
Competency	1
Tug failure (towing equipment)	1
Increased traffic density – Sailing events	1
Loss of vessels stability (due to other than loss of watertight integrity)	1
High traffic density	1
Failure to use navigational aids	1
Change in navigational environment	1
Barge obscured by infrastructure	1
Failure of a spud leg	1
Failure of berth mooring systems	1
Project/ time pressure	1

Table 18. Hazard Scenario Causes - Operation

Causes	Count (max 7)
Adverse weather	4
Equipment failure (on vessel)	3
Miscommunication (Master/ Pilot)	3
Misjudged manoeuvre	3
Tug failure	2
Visibility - hours of darkness	2
Change in navigational environment	1
Conning position change failure – (Bridgewing control)	1
Failure to adhere to COLREGs	1
Human error	1
Towage breakout/ lines failing	1
Poor traffic management	1
Reduced navigable water	1
Traffic density	1

In consideration of the most frequent of theses causes across the individual hazards:

Human Error: may be a judgment or a mistake in a repeated task, human error can lead to groundings, collisions, or spills, posing immediate threats to marine ecosystems and habitats.

Adverse weather conditions: storm conditions, high winds and heavy precipitation can impair vessel stability and navigation, increasing the likelihood of accidents. Such conditions may also exacerbate the consequences of other causes, amplifying their overall impact.

Equipment failure: equipment failure was noted to be a highly recurring causal factor. Malfunctioning propulsion systems, navigation instruments, or onboard machinery can compromise vessel integrity and safety, potentially leading to spills or accidents with severe consequences.

Lack of situational awareness: a reduction in situational awareness can impact on marine operations. Failure to maintain situational awareness can lead to collisions, groundings, or other accidents with significant consequences.

Miscommunication: poor communication among crew members, port authorities, or other stakeholders can have negative implications for marine operations. This may result in navigational errors, delays in response to emergencies, or misunderstandings that escalate into other incidents.

7.3 Embedded risk controls

During the risk analysis, each hazard scenario was considered in the context of the existing ('embedded') risk controls in place at FDEC that related to each hazard scenario. Embedded risk controls relate to processes, practices and available safety resources that are in existence with the aim to mitigate the consequence or likelihood of an incident occurring during marine operations. Table 19 and Table 20 present the embedded risk controls for the demolition and construction and operation stages, along with an occurrence count for each.

Table 19. Embedded Risk Controls - Construction

Embedded Risk Control	Count (max 12)
SOPs	12
CDM Regulations	9
Constructor RAMs	9
Communication equipment and standards	8
COLREGs	7
Professional standards/ training	7
Appropriate towage	6
Local Port Services	6
Passage planning	6
Pilotage directions	6
General/ Special directions	5
Port emergency plan	5
Equipment maintenance	4
PPE	4
Construction sequencing plan	3
Notice to Mariners	3
Safe Systems Of Work (H&S)	3
Accurate tidal measurements	2

Embedded Risk Control	Count (max 12)
Availability of latest hydrographic information	2
Availability of pollution response equipment	2
Emergency services equipment - shore side	2
Hydrographic Survey	2
Portable Pilot Unit	2
Diving at Work Regulations 1997 compliance	1
Escort Vessels	1
Harbour patrol boat	1
Loading/ unloading plan	1
Project planning	1
Promulgation of current local weather	1
Shore side signage	1
Training of port marine/ operations personnel	1
Vessel maintenance	1
Vessel's own safety procedure	1

Table 20. Embedded Risk Controls - Operation

Embedded Risk Control	Count (max 7)
Appropriate towage	7
SOPs	7
Passage planning	6
Pilotage directions	6
Escort vessels	4
Portable Pilot Unit	3
Non-routine towage process	3
Interface of respective MSMS for respective SHAs	3
MetOcean prediction, weather downtime review	3
Local Port Services	3
Professional standards/ training	2
COLREGs	1
Communication equipment and standards	1
Promulgation of current local weather	1
Hydrographic Survey	1
Accurate tidal measurements	1
Availability of latest hydrographic information	1

The most frequent controls are expanded on below:

Standard Operating Procedures (SOPs): SOPs are procedures that dictate how tasks should be performed in various operational scenarios. SOPs play a role in reducing both the likelihood and consequence of incidents in marine operations. SOPs provide a standardised framework for conducting routine tasks, aiding consistency .

Construction (Design and Management) Regulations 2015 (CDM Regulations): CDM Regulations are a legal requirement supported by Health and safety Executive (HSE) Guidance that focusses on planning, management of risk, cooperation, coordination, communication, and consultation. The principles are similar to those that underpin an MSMS.

Constructor Risk Assessment and Method Statements (RAMs): Constructor RAMs are detailed documents that outline the specific risks associated with construction activities and the corresponding control measures to mitigate them. They are a requirement of CDM regulations.

Communication Equipment and Standards: Effective communication is essential for safe and efficient marine operations. Communication equipment and standards are established by FDEC in their MSMS and are a requirement of CDM regulations for the proposed construction contractor.

International Regulations for Preventing Collisions at Sea (COLREGs): COLREGs are a set of rules established by the International Maritime Organization (IMO) to help prevent collisions and other navigational incidents at sea. Unless expressly adjusted by an SHA they apply to all vessels at all times in all navigable waters.

Professional Standards/Training: Professional standards and training programs are essential for ensuring that relevant personnel possess the necessary skills, knowledge, and competency to perform their duties safely and effectively. These standards are a requirement of an MSMS, CDM regulations and for commercial vessels (STCW) and commercial diving operations.

Appropriate Towage: Harbour Towage is a key control applied in maritime operations. The relevant SHAs in the study area issue towage guidelines within their MSMSs which will also be applied for construction traffic. The availability of tugs is also a control measure in circumstances of vessels becoming distressed.

7.4 Risk analysis: Embedded risk outcomes

Table 21 sets out the risk outcomes for the embedded hazard scenarios with assessed assumptions in respect to tolerability and ALARP.

Table 21. Hazard Scenarios Ranked by Embedded Risk Outcomes

Risk ID.	Hazard Category	Hazard Scenario Title		Embedded Risk Outcomes per Receptor				Embedded Risk Outcome
				People	Property	Planet	Port	
C1	Collision	Small leisure vessel collides with barge	WC					Tolerable likely not ALARP
			ML					
C2	Collision	Large (>100 m) commercial vessel collides with construction vessel	WC					Tolerable possibly ALARP
			ML					
C3	Collision	Commercial (24-99 m) vessel collides with construction vessel	WC					Intolerable
			ML					
C4	Accidents to personnel	Man overboard during dredge/construction works	WC					Tolerable possibly ALARP
			ML					
C5	Accidents to personnel	Diving Operations associated with installation of cathodic protection	WC					Tolerable possibly ALARP
			ML					
C6	Stranding/ Grounding	Construction Craft/ Backhoe Dredger grounds whilst conducting works	WC					Tolerable possibly ALARP
			ML					
C7	Collision	Backhoe Dredger / Dumb Barge & Tow / Self-propelled Construction Craft with another vessel	WC					Tolerable possibly ALARP
			ML					
C8	Allision	Backhoe Dredger / Construction craft has an allision with port infrastructure	WC					Tolerable possibly ALARP
			ML					
C9	Stranding/ Grounding	Commercial vessel delivering construction components grounds during transit into harbour	WC					Tolerable possibly ALARP
			ML					
C10	Collision	Commercial vessel delivering construction components has a collision with another vessel during transit into harbour	WC					Tolerable likely not ALARP
			ML					
C11	Allision/ Contact	Commercial vessel delivering construction components has an allision with port infrastructure on approach	WC					Tolerable possibly ALARP
			ML					
C12	Payload Related Incident	Spud leg barge / Dumb barge and tow / Self-propelled Construction Craft have payload related incident	WC					Tolerable possibly ALARP
			ML					
O1	Allision/ Contact	Large cruise vessel (250-350 m) contact with port infrastructure	WC					Tolerable possibly ALARP
			ML					
O2	Allision/ Contact	Allision between a commercial vessel and Queen's Wharf extension	WC					Intolerable
			ML					
O3	Collision	Vessel leaving drydock makes contact with moored cruise vessel	WC					Intolerable
			ML					
O4	Allision/ Contact	Allision between Dead Tow / abnormal indivisible load (inc. FLOW) and port infrastructure / contact with berthed vessel	WC					Intolerable
			ML					
O5	Other (Towage Breakout)	Dead Tow / abnormal indivisible load (inc. FLOW) breaks free from its tow	WC					Intolerable
			ML					
O6	Collision	Dead Tow / abnormal indivisible load (inc. FLOW) collides with another vessel	WC					Tolerable likely not ALARP
			ML					
O7	Stranding/ Grounding	Dead Tow / abnormal indivisible load (inc. FLOW) grounds during transit between FDEC and sea	WC					Intolerable
			ML					

7.5 Risk Analysis discussion

This section discusses the hazard scenarios which after the embedded risk outcomes have been identified as intolerable. After consideration of the potential future controls are the hazard scenarios tolerable. The six hazards identified as intolerable at the embedded stage of the risk assessments are discussed below.

7.5.1 Demolition and Construction

C3 - Collision Commercial (24-99 m) vessel collides with construction vessel

During the demolition and construction stage of the proposed development, additional vessel traffic will be using the study area. This includes construction and dredging craft associated with the land reclamation, construction of the wharfs and removal of the dredge material. Work craft and construction vessels associated with these operations will displace general marine traffic away from the works area. This creates a risk of collision with construction/dredge craft and may increase vessel traffic density in displaced routes.

In the embedded stage this causes the risk to planet and port to be intolerable for a WC outcome with the embedded controls against the organisation's set tolerability thresholds. The WC hazard outcome is assessed to be a single fatality, greater than £1 million in property damage, Tier 3 pollution and negative international publicity potentially occurring once every 25 years.

The risk assessment therefore introduced potential future controls to reduce risk to a tolerable and ALARP state, these controls include:

- Additional towage;
- Notice to Mariners;
- Marine management plan;
- Special category risk assessments;
- Wider communications;
- Exclusion zone; and
- Marine Liaison Officer.

These potential future controls all reduce the likelihood of the hazard from occurring, with three also reducing the consequence of the hazard scenario. As a result, the likelihood of this hazard scenario has reduced from 1 in 25 years to 1 in 50 years; making the risk outcome tolerable against the threshold set by FDEC.

7.5.2 Operation

O2 - Allision/ Contact Allision between a commercial vessel and Queen's Wharf extension

During the operation there is a risk of commercial vessels making contact with the Queen's Wharf extension. This may result in more frequent allisions or less serious contact from vessels departing Dutchy and County Wharfs.

In the embedded stage this causes the port risk to be intolerable for a WC outcome with the existing embedded controls. The assessed WC hazard outcome results in a scenario where there could be serious injuries to people, greater than £1 million in property damage, Tier 2 pollution and negative international publicity which occurs once every 25 years.

The risk assessment therefore introduced future additional controls to reduce risk to a tolerable and ALARP state, these controls include:

- New/Additional AtoN;
- Reduced usage of Duchy/County Wharves for larger vessels;
- Scheme proposed dredge area;
- Additional towage;
- Dynamic under keel clearance; and
- Special category risk assessments.

These potential future controls all reduce the likelihood of the hazard from occurring with one slightly reducing the consequence of the hazard scenario. As a result, the likelihood of this hazard scenario has reduced from 1 in 25 years to 1 in 50 years and the consequence for all four receptors have reduced which makes the risk tolerable against the threshold set by FDEC.

O3 - Collision Vessel leaving drydock makes contact with moored cruise vessel

During the operational stage, there is a risk of vessels leaving the dry dock and colliding with moored vessels on the new Western Wharf suspended deck. The land reclamation and extension of the Western Wharf will change the method for entering and exiting the dry docks, as there is less sea room, providing the potential for collisions with vessels manoeuvring out of the dry dock.

In the embedded state, the risk to port infrastructure is assessed to be intolerable in the WC scenarios. The WC hazard outcome results in a scenario which is assessed to be a single fatality, greater than £1 million in property damage, Tier 2 pollution and negative international publicity which occurs once every 25 years.

The risk assessment therefore introduced potential future controls to reduce risk to a tolerable and ALARP state, these controls include:

- Alternate berthing options;
- Safety boat;
- Vessel functionality test; and
- Weather restrictions.

These potential future controls all reduce the likelihood of the hazard from occurring. As a result, if implemented, the likelihood of this hazard scenario has reduced from 1 in 25 years to 1 in 50 years which makes the risk now tolerable against the threshold set by FDEC.

O4 - Allision/ Contact Allision between Dead Tow / abnormal indivisible load (inc. FLOW) and port infrastructure / contact with berthed vessel

There is a risk of a dead tow / abnormal indivisible loads under tow making contact with port infrastructure or contacting with berthed vessels. The floating infrastructure could impact with fixed port infrastructure or other vessels during main areas of the operations from berthing unberthing and port moves and possibly mooring breakaways in adverse weather.

In the embedded stage this causes the risk to port to be intolerable for a WC outcome with the embedded controls against the organisation's set tolerability thresholds. The current WC hazard outcome results in a scenario where it is assessed that a single fatality, greater than £1 million in property damage, Tier 2 pollution and negative international publicity which occurs once every 25 years. For the ML outcome which is also intolerable in the embedded stage the hazard is assessed to be minor injuries

to people, greater than £1 million in property damage, Tier 1 pollution with no measurable impact and negative international publicity which occurs once every 10 years.
The risk assessment therefore introduced potential future controls to reduce risk to a tolerable and ALARP state, these controls include:

- Simulation;
- Layby emergency berth;
- Scheme design;
- Mooring design parameters; and
- Special category risk assessments.

These potential future controls reduce the likelihood of the hazard from occurring with the layby emergency reducing the consequence of the hazard scenario. As a result, the likelihood of this hazard scenario has reduced from 1 in 25 years to 1 in 50 years and the consequence for all four receptors have reduced which makes the risk tolerable against the threshold set by FDEC.

O5 - Other (Towage Breakout) Dead Tow / abnormal indivisible load (inc. FLOW) breaks free

Larger abnormal tows, such as those used in transiting FLOW components, introduce a risk that the structure could potentially break free from their towage moorings as a result of adverse weather, incorrect manoeuvres, line failure or tug failure. The floating unpowered load which breaks free could then impact with port infrastructure or vessels in the vicinity.

In the embedded stage this causes the risk to port to be intolerable for a WC outcome with the embedded controls against the organisation's set tolerability thresholds. The WC hazard outcome results in a scenario assessed to be; a single fatality, greater than £1 million in property damage, Tier 1 pollution and negative international publicity which occurs every 25 years.

The risk assessment introduced potential future controls to reduce risk to a tolerable and ALARP state, these controls include:

- Simulation;
- Layby emergency berth;
- Towage Plan, approved by FHC and FDEC for passage through respective SHAs;
- Mooring design parameters; and
- Special category risk assessments.

These potential future controls all reduce the likelihood of the hazard from occurring with the layby emergency reducing the consequence of the hazard scenario. As a result, the likelihood of this hazard scenario has reduced from 1 in 25 years to 1 in 50 years and the consequence for people reduces to 'serious injuries' in the worst credible scenario which is considered tolerable against the threshold set by FDEC.

O7 - Stranding/ Grounding Dead Tow / abnormal indivisible load (inc. FLOW) grounds during transit between FDEC and sea

When manoeuvring large abnormal tows or individual elements, such as those used in FLOW operations, there is a risk that the tow, with much greater draught, could strand or ground during transit. A stranding or grounding scenario could be result from a number of different causes such as adverse weather, incorrect/ misjudged manoeuvres, Pilot/ Master miscommunication, line failure and or tug failure.

In the embedded stage this causes the risk to port to be intolerable for a WC outcome with the embedded controls considered against the organisation's set tolerability thresholds. The WC hazard outcome results in a scenario assessed to be; serious injuries, greater than £1 million in property damage, minor tier 1 pollution and negative international publicity which occurs every 25 years.

The risk assessment introduced potential future controls to reduce risk to a tolerable and ALARP state, these controls include:

- Simulation;
- Towage Plan, approved by FHC and FDEC for passage through respective SHAs;
- Mooring design parameters; and
- Special category risk assessments.

These potential future controls all reduce the likelihood of the hazard from occurring. None of the potential future controls reduced the consequence of the hazard scenario. As a result, the likelihood of this hazard scenario has reduced from 1 in 25 years to 1 in 50 years which makes the risk tolerable against the threshold set by FDEC.

7.6 Potential Future Controls

Table 22 and Table 23 set out the identified potential future controls for demolition and construction and operation of the proposed development respectively along with an occurrence count to aid understanding which of these potential future controls has the widest application. This assists an organisation in determining which of the potential future controls should be applied to ensure that an ALARP state is reached. Importantly, the count associated with each future control should not be interpreted as a measure of the control's effectiveness in reducing the likelihood and/or consequence of risk outcomes.

Table 22. Future Risk Controls – Demolition and Construction

Future Control	Count (max 12)
Marine Liaison Officer	10
Marine management plan	10
Special category risk assessments	6
Wider communications	6
Additional towage	4
Dedicated VHF channel	3
Exclusion zone	3
Notice to Mariners	3
Contractor risk assessment method statement (RAMS)	2
Safety boat	2
Additional General/ Special directions	1
Dynamic under keel clearance	1
Increased engagement with sailing clubs	1
Scheme proposed dredge area	1
New/ Additional Aids to Navigation	1
Reduced usage of Duchy/ County (berths) for larger vessels	1
Timings - liaison plan	1

Table 23. Potential Future Controls - Operation

Potential Future Controls	Count (max 7)
Special category risk assessments	5
Simulation	5
Towage Plan, approved by FHC and FDEC for passage through respective SHAs	3
Additional towage	2
Mooring design parameters	3
New/ Additional Aids to Navigation	2
Layby emergency berth	2
Additional Portable Pilot Unit	1
Alternate berthing options	1
Dynamic under keel clearance	1
Scheme proposed dredge area	1
Exclusion Zone	1
Reduced usage of Duchy/ County for larger vessels	1
Safety boat	1
Scheme design	1
Specific ship type training for pilots	1
Vessel functionality test	1
Weather restrictions	1
Wharf design	1

7.6.1 Both Demolition and Construction, and Operation

Special Category Risk Assessments: Special Category Risk Assessments identify and evaluate specific risks associated with port construction and operational activities, such as dredging, pile driving, or vessel movements in sensitive areas. By conducting specialized risk assessments, project teams can implement targeted mitigation measures to minimise the likelihood and consequences of potential hazards.

Exclusion Zone: Implementing an exclusion zone around construction activities will be a requirement of CDM regulations in respect to the control of areas that are active construction areas. Additionally, exclusion zones are often used to keep vessels separate from substantial movements, especially during pilotage. As such an exclusion zone could be applied to or abnormal/ indivisible towage operations (including FLOW) to reduce risks associated.

Additional Towage: Providing additional towage (where appropriate) during port construction and future operations can enhance safety and operational efficiency during vessel movements particularly in challenging conditions or confined spaces. Additional towage above what might normally be used in novel situations mitigates the likelihood of a vessel having an incident overall risk management during port construction activities and marine operations.

New / Additional Aids to Navigation (AtoN): As part of the proposed development, the Local Lighthouse Authorities will consider any appropriate adjustments to Aids to Navigation and if considered necessary they may be implemented in consultation with Trinity House (as the General Lighthouse Authority (GLA)). Installing new/ additional Aids to Navigation (virtual or otherwise), such as buoys, beacons, AIS markers, or lights, enhances navigational safety and awareness. By marking hazards and guiding vessel movements, AtoN reduce the risk of navigational errors, groundings, and collisions.

Dynamic Under Keel Clearance (DUKC): Dynamic Under Keel Clearance (DUKC) integrates real time measurement of tides and waves with modelled vessel motions to maximise port efficiency and safety. By accounting for tidal variations, wave height, and vessel hydrodynamic response to draught (squat, roll, heave, pitch), project teams optimise navigational safety and reduces the risk of accidents or disruptions.

Scheme Proposed Dredge Area: The proposed dredge area will help to increase operational flexibility and efficiency; reducing the risks of grounding and enabling additional manoeuvring options when arriving and departing berths.

Safety Boat: Deploying a safety boat during port construction activities provides potential for rapid response in case of emergencies, as well as acting as a guard boat. If taken forward, the exact function and circumstances of its use will be determined by the relevant organisations.

Reduced Usage of Duchy/ County for Larger Vessels: The new development has the potential to reduce the usage of Duchy and County wharfs especially by larger vessels as they will be able to have berths allocated elsewhere. In doing this, the difficulty of berthing will be reduced and the wash that is currently experienced from these larger vessels berthing at Pendennis Marina will be less as well.

7.6.2 Demolition and Construction only

Marine Liaison Officer: A Marine Liaison Officer serves as a point of contact between development contractors and the organisation responsible for marine safety. By facilitating effective communication and collaboration, the Marine Liaison Officer helps identify and address concerns, mitigate potential conflicts, and assists compliance with regulations.

Marine Management Plan: A plan developed between the construction contractors and the organisation responsible for marine safety. The intention of the plan is that it outlines the procedures in place for each organisation as required by their own requirements, for example, MSMS and CDM, specific examples being contingencies, lines, and circumstances of communication and how those procedures interface and deconflict. The intended outcome is shared understanding.

Wider Communications: Wider communications (including social media) involves engaging a broader range of stakeholders beyond immediate project participants, including local communities, groups, and recreational users of the marine area. This provides stakeholder awareness of construction operations.

Dedicated Very High Frequency (VHF) Channel: Establishing a dedicated VHF channel for communication between construction vessels, port authorities, and other stakeholders improves coordination and safety during port construction operations. By providing a reliable communication platform, the dedicated VHF channel reduces the risk of misunderstandings, delays, and navigational errors, enhancing situational awareness and response capabilities.

Notice to Mariners: Issuing Notice to Mariners alerts marine stakeholders, including vessel operators and navigational authorities, about temporary changes or hazards related to port construction activities. This is an established embedded control as part of the relevant Organisations MSMS and is considered as a future control as promulgation of pertinent construction activities (as they arise) to identify requirements of marine stakeholders operating in the area.

Contractor Risk Assessment Method Statement (RAMS): Though discussed as a potential future control at the HAZID and Risk Assessment Workshop, this control is considered embedded (and covered in the previous section) as it is a requirement of CDM regulations. The future component of this control is that the specific RAMS are not yet in place but will be developed at the appropriate time.

Additional Harbour / Special Directions / Pilotage Directions: FDEC have powers of Harbour / Special Directions in force that may be usefully applied to assist the management of marine safety during the construction and operational stages of the proposed development. To introduce new General or Harbour Directions under the existing powers may require a consultative process. The powers of Special Direction of relevant Organisations may be particularly useful to manage specific situations with specific vessels in the interest of safety.

Increased Engagement with Sailing Clubs: Specific communication and planned engagement with local sailing and water sport clubs will assist with safety messaging and shared understanding of the proposed construction works. Engaging with sailing clubs and recreational boating communities fosters awareness, cooperation, and support for port construction activities. By consulting with sailing clubs on construction schedules, navigational impacts, and safety considerations, project teams reduce the risk of conflicts, complaints, and opposition from recreational users of the marine area.

Timings - Liaison Plan: This is considered as a subset of the Marine Management Plan; developing a liaison plan for coordinating construction activities with other marine users, such as commercial shipping, fishing fleets, or recreational boaters, optimizes timing to minimise conflicts and disruptions. Effective timing coordination enhances efficiency, minimises navigational risks, and fosters positive relationships with other marine stakeholders, supporting overall risk management during construction.

7.6.3 Operation only

Simulation: Is a well-established method used to inform projects, feasibility studies and assessments an example use in this context is in familiarisation, and training related to new vessel types and sizes on to new infrastructure, as well as the towage of abnormal/ indivisible loads through from the harbour to sea or *vice versa*.

Additional Portable Pilot Unit: Deploying additional Portable Pilot Units (PPUs) enhances navigational safety and efficiency by providing pilots a backup system with real-time vessel position information and navigational assistance. By providing additional PPUs as a redundancy, FDEC would improve situational awareness, minimise the risk of navigational errors, and facilitate safe manoeuvring in confined or challenging waterways.

Alternate Berthing Options: Identifying and developing alternate berthing options allows FDEC to mitigate the risk of congestion, delays, or operational disruptions. Alternate berthing options enhance operational flexibility and minimise the likelihood of logistical challenges.

Towage Plan, approved by FHC and FDEC for passage through respective SHAs: Agreeing a towage plan with FHC for the movement of specific abnormal/ indivisible loads (e.g. FLOW turbines) ensures that all relevant stakeholders have considered the risks associated and how best to manage them.

Layby Emergency Berth: Establishing a layby emergency berth provides designated areas where vessels (and their tow if applicable) can temporarily dock in emergency situations, such as medical emergencies, equipment failures, or adverse weather conditions. By offering safe refuge options, layby emergency berths minimise the risk of accidents, injuries, or environmental damage resulting from emergency manoeuvres or distress situations. Layby emergency berths enhance emergency preparedness, mitigate operational risks, and support safe navigation during FLOW movement activities. Special category moves, including FLOW towage, requires a nominated emergency layby berth however this will not necessarily be a permanent feature for normal operation of the docks.

Mooring Design Parameters: Designing mooring systems with appropriate parameters, such as bollard strength, line tension limits, and fendering requirements, ensures safe and secure vessel mooring during port operations. By specifying mooring design parameters based on vessel types, sizes (including FLOW turbines), and operational conditions, project teams and FDEC minimise the risk of mooring failures, accidents, or structural damage as a result. Adhering to mooring design standards enhances operational safety, reduces the likelihood of incidents, and supports efficient port construction activities.

Scheme Design: Developing a comprehensive scheme design for port construction involves planning and integrating various elements, including infrastructure layout, dredging plans, navigational aids, and environmental considerations. By carefully designing the overall construction scheme, project teams optimise resource allocation, minimise environmental impacts, and ensure operational efficiency. A well-designed scheme reduces the likelihood of operational bottlenecks, ultimately enhancing overall risk management effectiveness during operations.

Specific Ship Type Training for Pilots: Providing specialised training for pilots on handling specific ship types (including FLOW turbines) enhances navigational safety and efficiency. By familiarising pilots with the characteristics, manoeuvring capabilities, and handling requirements of different vessel types, FDEC can reduce the risk of navigational errors and accidents. Specific ship type training improves pilot competence, enhances situational awareness, and supports safe vessel navigation, contributing to overall risk reduction during operations.

Vessel Functionality Test: Conducting functionality tests on vessels leaving dry dock ensures that they meet operational requirements and safety standards before departing their berths. Vessel functionality tests minimises the likelihood of malfunctions and reduces risk when vessels depart dry dock.

Weather Restrictions: Implementing additional/new weather restrictions during certain activities helps mitigate the risk of adverse weather impacts on safety, operational efficiency, and environmental management. By monitoring weather forecasts and establishing criteria for permissible weather conditions, FDEC and project teams minimise the risk of weather-related accidents. Weather restrictions enhance safety, reduce the likelihood of weather-related delays or damages, and support effective risk management.

Wharf Design: Designing wharves with appropriate specifications, including structural integrity, berthing capacity, and navigational access, ensures safe and efficient vessel mooring. By incorporating robust design standards and engineering principles, project teams minimise the risk of wharf failures or structural collapses.

7.7 Risk analysis: Potential risk outcomes

Table 24 sets out the risk outcome for the hazard scenarios following implementation of the future additional control options identified in this NRA. The potential risk outcomes consider the potential likelihood reduction and consequence reduction from each future additional risk control considered.

In some instances, the risk ratings remain the same after the potential future controls are applied. This is because although the potential future controls proposed are beneficial to the level of risk, the control has not created sufficient change to move the risk outcome to the next category (e.g., 1/25 years to 1/50 years). Nevertheless, the identified potential future controls represent good practice and should not be disregarded simply because the risk outcome is the same.

Table 24. Hazard Scenarios Ranked by Potential Risk Outcomes

Risk ID.	Hazard Category	Hazard Scenario Title		Potential Risk Outcomes per Receptor				Potential Risk Outcome
				People	Property	Planet	Port	
C1	Collision	Small leisure vessel collides with barge	WC					Tolerable and ALARP
			ML					
C2	Collision	Large (>100 m) commercial vessel collides with construction vessel	WC					Tolerable and ALARP
			ML					
C3	Collision	Commercial (24-99 m) vessel collides with construction vessel	WC					Tolerable and ALARP
			ML					
C4	Accidents to personnel	Man overboard during dredge/construction works	WC					Tolerable and ALARP
			ML					
C5	Accidents to personnel	Diving Operations associated with installation of cathodic protection	WC					Tolerable and ALARP
			ML					
C6	Stranding/ Grounding	Construction Craft/ Backhoe Dredger grounds whilst conducting works	WC					Tolerable and ALARP
			ML					
C7	Collision	Backhoe Dredger/ Dumb Barge & Tow/ Self-propelled Construction Craft with another vessel	WC					Tolerable and ALARP
			ML					
C8	Allision	Backhoe Dredger/ Construction craft has an allision with port infrastructure	WC					Tolerable and ALARP
			ML					
C9	Stranding/ Grounding	Commercial vessel delivering construction components grounds during transit into harbour	WC					Tolerable and ALARP
			ML					
C10	Collision	Commercial vessel delivering construction components has a collision with another vessel during transit into harbour	WC					Tolerable and ALARP
			ML					
C11	Allision/ Contact	Commercial vessel delivering construction components has an allision with port infrastructure on approach	WC					Tolerable and ALARP
			ML					
C12	Payload Related Incident	Spud leg barge/ Dumb barge and tow/ Self-propelled Construction Craft have payload related incident	WC					Tolerable and ALARP
			ML					
O1	Allision/ Contact	Large cruise vessel (250-350 m) contact with port infrastructure	WC					Tolerable and ALARP
			ML					
O2	Allision/ Contact	Allision between a commercial vessel and Queen's Wharf extension	WC					Tolerable and ALARP
			ML					
O3	Collision	Vessel leaving drydock makes contact with moored cruise vessel	WC					Tolerable and ALARP
			ML					
O4	Allision/ Contact	Allision between Dead Tow / abnormal indivisible load (inc. FLOW) and port infrastructure / contact with berthed vessel	WC					Tolerable and ALARP
			ML					
O5	Other (Towage Breakout)	Dead Tow / abnormal indivisible load (inc. FLOW) breaks free from its tow	WC					Tolerable and ALARP
			ML					
O6	Collision	Dead Tow / abnormal indivisible load (inc. FLOW) collides with another vessel	WC					Tolerable and ALARP
			ML					
O7	Stranding/ Grounding	Dead Tow / abnormal indivisible load (inc. FLOW) grounds during transit between FDEC and sea	WC					Tolerable and ALARP
			ML					

8 Summary

The proposed development would redevelop and modernise the existing facilities at Falmouth Docks to reinstate full alongside berth capability and increase berth capacity. The objectives of the proposed development are to repair and update the currently poor condition port infrastructure in order to maintain existing business and future proof the docks with respect to cruise capacity, cargo capacity and renewable floating offshore wind (FLOW) (supporting the offshore wind market).

For the demolition and construction, and operational stages of the proposed development, 12 construction based hazard scenarios, and seven operational hazards scenarios were identified. These scenarios encompass a variety of potential risks including collision, allision, contact, grounding, stranding, towage breakout, and payload related accidents. In consideration of these navigational hazards, a range of (potential) potential future controls have been identified, that FDEC, as the organisation responsible for safe navigation within their SHA, can consider, mitigating the risk outcomes associated with the proposed development.

Through the considered application of the 28 different potential future controls identified across the demolition and construction and operational stages, FDEC and the project team will be able to effectively manage the risks associated, ensuring activities are both tolerable and ALARP. These potential future controls are listed and described in Section 7.6.

9 References

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10 Abbreviations/Acronyms

ACD	Admiralty Chart Datum
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AtoN	Aids to Navigation
CCTV	Closed-Circuit Television
CD	Chart Datum
CDM	Construction (Design and Management) Regulations
CHA	Competent Harbour Authority
COLREGs	International Regulations for Preventing Collisions at Sea
DfT	Department for Transport
DUKC	Dynamic Under Keel Clearance
DWT	Deadweight Tonnage
EIA	Environmental Impact Assessment
ES	Environmental Statement
FDEC	Falmouth Docks and Engineering Company
FHC	Falmouth Harbour Commissioners
FLOW	Floating Offshore Wind
FSA	Formal Safety Assessment
GtGP	Guide to Good Practice on Port Marine Operations
GIS	Geographic Information System
GLA	General Lighthouse Authority
GT	Gross Tonnage
GW	Gigawatt
H&S	Health and Safety
HAZID	Hazard Identification
HSE	Health and Safety Executive
ID	Identity
IMO	International Maritime Organization
LLA	Local Lighthouse Authority
LPS	Local Port Services
M	Million
MAIB	Marine Accident Investigation Branch
ML	Most Likely
MLA	Marine Licence Application
MoB	Man over-board
MoD	Ministry of Defence
MS	Merchant Shipping
MSMS	Marine Safety Management System
NRA	Navigational Risk Assessment
PEC	Pilot Exemption Certificate
PMSC	Port Marine Safety Code
PPE	Personal Protective Equipment

PPU	Portable Pilot Unit
RAMS	Constructor Risk Assessment and Method Statements
RFA	Royal Fleet Auxiliary
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
SHA	Statutory Harbour Authority
SMS	Safety Management System
SOP	Standard Operating Procedure
STCW	Standards of Training, Certification and Watchkeeping
SUP	Stand-Up Paddleboard
UK	United Kingdom
VHF	Very High Frequency
WC	Worst Credible
WGS	World Geodetic System

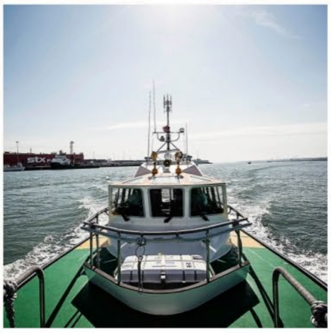
Cardinal points/ directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendices







Innovative Thinking - Sustainable Solutions

A Navigational Risk Assessment: Construction

Table A1. Hazard Category: Collision; Scenario: Small Leisure vessel collides with barge; Risk ID C1

Hazard Category	Collision	**Hazard Scenario Title**	Small leisure vessel collides with barge	**Risk ID**	C1

Risk Analysis	**Embedded Controls**	
Causes	**Controls**	**Comment**
Lack of situational awareness	Notice to Mariners	
Failure to adhere to COLREGs	Local Port Services	Managing movements
Restricted/ Poor visibility	COLREGs	
Failure to use navigational aids	General/ Special directions	Speed limit
Competency	Harbour patrol boat	
Increased traffic density – Sailing events	Professional standards/ training	
Barge obscured by infrastructure	SOPs	Emergency Plans including oil pollution
Human error	CDM regulations	Added during post-HAZID correspondence
	Constructor RAMs	Added during post-HAZID correspondence
	Construction sequencing plan	Added during post-HAZID correspondence

WC Scenario	**ML Scenario**
Small leisure vessel makes significant contact at speed with barge, with the potential to result in: ▪ Serious injuries, ▪ £100,000 to £1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative local publicity. This was estimated to potentially occur once in every 10 years if construction occurred continuously throughout the period with embedded controls only.	Small leisure vessel makes contact (glancing blow) with barge after taking avoiding action, with the potential to result in: ▪ No injuries, ▪ £2,000 - £ 10,000 in property damage, ▪ No pollution, and ▪ Minor local publicity. This was estimated to potentially occur once in every 5 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		**Embedded WC Consequence**			**Embedded ML Likelihood**		**Embedded ML Consequence**		
Occasionally	3	**People**	2	Moderate	Probable	4	**People**	0	Negligible
		Property	3	Major			**Property**	1	Minor
		Planet	3	Major			**Planet**	0	Negligible
		Port	2	Moderate			**Port**	1	Minor

(Potential) Future additional controls	**Comment**	**Likelihood Mitigation**	**Consequence Mitigation**
Controls			
Exclusion zone	Special marks - AtoN	Medium	Nil
Wider communications	Social media	Low	Nil
Increased engagement with sailing clubs		Low	Nil
Safety boat		Medium	Nil
Timings - liaison plan	Deconfliction with events	Low	Nil
Additional General/ Special directions	Reduced speeds, minimum clearing distances, exclusion zones	Low	Nil

Potential WC Likelihood		**Potential WC Consequence**			**Potential ML Likelihood**		**Potential ML Consequence**		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	0	Negligible
		Property	3	Major			**Property**	1	Minor
		Planet	3	Major			**Planet**	0	Negligible
		Port	2	Moderate			**Port**	1	Minor

Table A2. Hazard Category: Collision; Scenario: Large (>100 m) commercial vessel collides with construction vessel; Risk ID C2

Hazard Category	Collision	Hazard Scenario Title	Large (>100 m) commercial vessel collides with construction vessel	Risk ID	C2

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
Equipment failure (on vessel)	Pilotage directions	
Lack of situational awareness	Communication equipment and standards	VHF, LPS
Human error	Professional standards/ training	
Fatigue	Equipment maintenance	
Adverse weather	Passage planning	
Miscommunication	Appropriate towage	
Traffic management error – Port planning	Notice to Mariners	
Failure to adhere to COLREGs	General/ Special directions	Especially speed limits
	Local Port Services	Managing movements
	COLREGs	
	SOPs	Emergency Plans including oil pollution response
	CDM regulations	Added during post-HAZID correspondence
	Constructor RAMs	Added during post-HAZID correspondence
	PPE	Added during post-HAZID correspondence
	Escort Vessels	Added during post-HAZID correspondence
	Construction sequencing plan	Added during post-HAZID correspondence

WC Scenario	ML Scenario
Significant collision between a manoeuvring construction vessel and a large commercial vessel proceeding to/from its berth, with the potential to result in: ▪ Single fatality, ▪ >£1 million in property damage, ▪ Tier 3 pollution event, and ▪ Negative international publicity. This was estimated to potentially occur once in every 50 years if construction occurred continuously throughout the period with embedded controls only.	A collision between a large commercial vessel and a construction vessel at low speed following attempts to take avoiding action, with the potential to result in: ▪ Minor injuries, ▪ £100,000 - £1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Minor local publicity. This was estimated to potentially occur once in every 50 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Very Unlikely	1	**People**	3	Major	Very Unlikely	1	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	4	Extreme			**Planet**	1	Minor
		Port	4	Extreme			**Port**	1	Minor

(Potential) Future additional controls	Comment	Likelihood Mitigation	Consequence Mitigation
Controls			
Additional towage	Escort towage	Low	Low
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low
Special category risk assessments	Additional Safe Systems of Work	Low	Nil
Wider communications	Social media	Low	Nil
Exclusion zone		Low	Nil
Marine Liaison Officer	Added during post-HAZID correspondence	Low	Low

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	2	Moderate	Very Unlikely	1	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	4	Extreme			**Planet**	1	Minor
		Port	4	Extreme			**Port**	1	Minor

Table A3. Hazard Category: Collision; Scenario: Commercial (24-99 m) vessel collides with construction vessel; Risk ID C3

Hazard Category	Collision	**Hazard Scenario Title**	Commercial (24-99m) vessel collides with construction vessel	**Risk ID**	C3

Risk Analysis	**Embedded Controls**	
Causes	**Controls**	**Comment**
Equipment failure (on vessel)	Pilotage directions	
Lack of situational awareness	Communication equipment and standards	VHF
Human error	Professional standards/ training	
Fatigue	Equipment maintenance	
Adverse weather	Passage planning	
Miscommunication	Appropriate towage	
Traffic management error – Port planning	General/ Special directions	
Failure to adhere to COLREGs	Local Port Services	Managing movements
	COLREGs	
	SOPs	Emergency Plans including Oil Pollution
	CDM regulations	Added during post-HAZID correspondence
	Constructor RAMs	Added during post-HAZID correspondence
	PPE	Added during post-HAZID correspondence
	Construction sequencing plan	Added during post-HAZID correspondence

WC Scenario	**ML Scenario**
Significant collision between a manoeuvring construction vessel and a commercial vessel proceeding to/from its berth with the potential to result in: ▪ Single fatality, ▪ >£1 million in property damage, ▪ Tier 3 pollution event, and ▪ Negative international publicity. This was estimated to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.	A collision between a commercial vessel and a construction vessel at low speed following attempts to take avoiding action with the potential to result in: ▪ Minor injuries, ▪ £100,000 - £1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Minor local publicity. This was estimated to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		**Embedded WC Consequence**			**Embedded ML Likelihood**		**Embedded ML Consequence**		
Unlikely	2	**People**	3	Major	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	4	Extreme			**Planet**	1	Minor
		Port	4	Extreme			**Port**	1	Minor

(Potential) Future additional controls	**Comment**	**Likelihood Mitigation**	**Consequence Mitigation**
Controls			
Additional towage	Escort towage	Low	Low
Notice to Mariners	Increased promulgation	Low	Nil
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low
Special category risk assessments	Additional Safe Systems of Work	Low	Nil
Wider communications	Social media	Low	Nil
Exclusion zone		Low	Nil
Marine Liaison Officer	Added during post-HAZID correspondence	Low	Low

Potential WC Likelihood		**Potential WC Consequence**			**Potential ML Likelihood**		**Potential ML Consequence**		
Very Unlikely	1	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	4	Extreme			**Planet**	1	Minor
		Port	4	Extreme			**Port**	1	Minor

Table A4. Hazard Category: Accidents to personnel; Scenario: Man overboard during dredge/ construction works; Risk ID C4

Hazard Category	Accidents to personnel	Hazard Scenario Title	Man overboard during dredge/ construction works	Risk ID	C4

Risk Analysis: Causes	Embedded Controls: Controls	Embedded Controls: Comment
Human error	Communication equipment and standards	
Inadequate procedures in place onboard vessel	Safe Systems Of Work (H&S)	
Interaction with recreational/ fishing craft	COLREGs	
Adverse weather	Emergency services equipment - shore side	Mayday or Pan-Pan call to Coastguards
Failure to comply with safe systems of work	SOPs	
Loss of vessels stability (due to other than loss of watertight integrity)	Vessel's own safety procedure	MoB drills and SOPs
Inadequate procedures shoreside	Port emergency plan	
Tug failure (towing equipment)	CDM regulations	
Failure of berth mooring systems	Constructor RAMs	
Lack of situational awareness	PPE	

WC Scenario

Man overboard incident with a significant injury during the dredge/construction works, with the potential to result in:

- Single Fatality,
- £0-£2,000 in property damage,
- No pollution, and
- Negative local publicity.

ABPmer estimate this to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.

ML Scenario

Man overboard incident following a trip/fall, with the potential to result in:

- Minor injuries
- £0-£2,000 in property damage,
- No pollution, and
- Minor local publicity.

ABPmer estimate this to potentially occur once in every 5 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Unlikely	2	**People**	3	Major	Probable	4	**People**	1	Minor
		Property	0	Negligible			**Property**	0	Negligible
		Planet	0	Negligible			**Planet**	0	Negligible
		Port	2	Moderate			**Port**	1	Minor

(Potential) Future additional controls: Controls	Comment	Likelihood Mitigation	Consequence Mitigation
Safety boat	On site, appropriate for recovering a MoB and ready for immediate use	Nil	Medium
Marine Liaison Officer	To provide safety information to vessels navigating and to consult with local authorities	Low	Low
Contractor risk assessment method statement (RAMS)		Low	Nil
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	0	Negligible			**Property**	0	Negligible
		Planet	0	Negligible			**Planet**	0	Negligible
		Port	2	Moderate			**Port**	1	Minor

Risk Assessed by ABPmer in addition to the HAZID workshop

Table A5. Hazard Category: Accidents to personnel; Scenario: Diving Operations associated with installation of cathodic protection; Risk ID C5

Hazard Category	Accidents to personnel	Hazard Scenario Title	Diving Operations associated with installation of cathodic protection	Risk ID	C5

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
High traffic density	Communication equipment and standards	
Failure to comply with safe systems of work	Notice to Mariners	
Flag 'A' not flying/ observed	Safe Systems Of Work (H&S)	Provided by contractors
Restricted/ Poor visibility	COLREGs	
Inadequate procedures shoreside	Emergency services equipment - shore side	Mayday or Pan-Pan call to Coastguards
Communication failure	SOPs	Provided by the vessels owners/ operators
Adverse weather	Shore side signage	A' flag displayed during operations
Human error	Port emergency plan	
	Diving at Work Regulations 1997 compliance	Provided by contractors
	CDM regulations	
	Constructor RAMs	
	PPE	

WC Scenario	ML Scenario
Diver in the water is impacted by vessel or vessel's propulsion, with the potential to result in: ▪ Single Fatality, ▪ £0-£2,000 in property damage, ▪ No pollution, and ▪ Negative national publicity ABPmer estimate this to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.	Diver in the water experiences interaction with moving vessel however escapes harm, work is ceased while investigation occurs, with the potential to result in: ▪ No injuries, ▪ £0-£2,000 in property damage, ▪ No pollution, and ▪ Minor local publicity. ABPmer estimate this to potentially occur once in every 10 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Unlikely	2	**People**	3	Major	Occasionally	3	**People**	0	Negligible
		Property	0	Negligible			**Property**	0	Negligible
		Planet	0	Negligible			**Planet**	0	Negligible
		Port	3	Major			**Port**	1	Minor

(Potential) Future additional controls	Comment	Likelihood Mitigation	Consequence Mitigation
Controls			
Marine Liaison Officer	To provide safety information to vessels navigating in the area and to local authorities	Low	Low
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low
Dedicated VHF channel		Low	Nil
Wider communications		Low	Nil

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	3	Major	Unlikely	2	**People**	0	Negligible
		Property	0	Negligible			**Property**	0	Negligible
		Planet	0	Negligible			**Planet**	0	Negligible
		Port	3	Major			**Port**	1	Minor

Risk Assessed by ABPmer in addition to the HAZID workshop

Table A6. Hazard Category: Stranding/ Grounding; Scenario: Construction Craft/ Backhoe Dredger grounds whilst conducting works; Risk ID C6

Hazard Category	Stranding/ Grounding	**Hazard Scenario Title**	Construction Craft/ Backhoe Dredger grounds whilst conducting works	**Risk ID**	C6

Risk Analysis	**Embedded Controls**	
Causes	**Controls**	**Comment**
Human error	Hydrographic Survey	
Foul ground obstructions	Communication equipment and standards	
Inaccurate charting (potential – foul ground)	Accurate tidal measurements	Tide level observed on-site and made available to vessels
Incorrect assessment of height of tide	Availability of latest hydrographic information	Survey provided in advance of the dredge
Communication failure	SOPs	Provided by the vessels owners/ operators
Lapse in survey and maintenance dredging programme	Availability of pollution response equipment	Shore side equipment provided by the Harbour Authority
	Port emergency plan	
	CDM regulations	
	Constructor RAMs	

WC Scenario	**ML Scenario**
Backhoe Dredger grounds on foul ground and becomes stranded requiring assistance to refloat, with the potential to result in: ▪ Serious injuries, ▪ £100,000 to £1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative local publicity. ABPmer estimate this to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.	Construction craft (e.g. barge) grounds temporarily whilst manoeuvring in close proximity to the shore, with the potential to result in: ▪ Minor injuries, ▪ £2,000 - £ 10,000 in property damage, ▪ No pollution, and ▪ Minor local publicity. ABPmer estimate this to potentially occur once in every 10 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		**Embedded WC Consequence**			**Embedded ML Likelihood**		**Embedded ML Consequence**		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	3	Major			**Property**	1	Minor
		Planet	3	Major			**Planet**	0	Negligible
		Port	2	Moderate			**Port**	1	Minor

(Potential) Future additional controls	**Comment**	**Likelihood Mitigation**	**Consequence Mitigation**
Controls			
Marine Liaison Officer	To provide safety information to vessels navigating in the area and to local authorities	Low	Low
Dedicated VHF channel		Low	Nil
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low

Potential WC Likelihood		**Potential WC Consequence**			**Potential ML Likelihood**		**Potential ML Consequence**		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	3	Major			**Property**	1	Minor
		Planet	3	Major			**Planet**	0	Negligible
		Port	2	Moderate			**Port**	1	Minor

Risk Assessed by ABPmer in addition to the HAZID workshop

Table A7. Hazard Category: Collision; Scenario: Backhoe Dredger/ Dumb Barge & Tow/ Self-propelled Construction Craft with another vessel; Risk ID C7

Hazard Category	Collision	**Hazard Scenario Title**	Backhoe Dredger/ Dumb Barge & Tow/ Self-propelled Construction Craft with another vessel	**Risk ID**	C7

Risk Analysis	**Embedded Controls**	
Causes	**Controls**	**Comment**
Equipment failure (on vessel)	Pilotage directions	
Lack of situational awareness	Communication equipment and standards	VHF
Human error	Professional standards/ training	
Fatigue	Equipment maintenance	
Adverse weather	Passage planning	
Miscommunication	Appropriate towage	
Traffic management error – Port planning	General/ Special directions	
Failure to adhere to COLREGs	Local Port Services	Managing movements
	COLREGs	
	SOPs	Emergency plans including oil pollution response

WC Scenario	**ML Scenario**
Backhoe Dredger has serious collision with a commercial vessel during transit, with the potential to result in: ▪ Serious injuries, ▪ >£1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative national publicity. ABPmer estimate this to potentially occur once in every 50 years if construction occurred continuously throughout the period with embedded controls only.	Construction Craft (including tow if dumb barge) responsible for the removal of dredge material to Falmouth Bay or transport of demolition material has minor collision with a commercial vessel after both take avoiding action, with the potential to result in: ▪ Minor injuries, ▪ £100,000 - £1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Minor local publicity. ABPmer estimate this to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		**Embedded WC Consequence**			**Embedded ML Likelihood**		**Embedded ML Consequence**		
Very Unlikely	1	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	3	Major			**Planet**	1	Minor
		Port	3	Major			**Port**	1	Minor

(Potential) Future additional controls	**Comment**	**Likelihood Mitigation**	**Consequence Mitigation**
Controls			
Notice to Mariners	Increased/ wider promulgation	Low	Nil
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low
Special category risk assessments	Additional Safe Systems of Work	Low	Nil
Wider communications	Social media	Low	Nil
Marine Liaison Officer		Low	Low

Potential WC Likelihood		**Potential WC Consequence**			**Potential ML Likelihood**		**Potential ML Consequence**		
Very Unlikely	1	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	3	Major			**Planet**	1	Minor
		Port	3	Major			**Port**	1	Minor

Risk Assessed by ABPmer in addition to the HAZID workshop

Table A8. Hazard Category: Allision; Scenario: Backhoe Dredger/ Construction craft has an allision with port infrastructure; Risk ID C8

Hazard Category	Allision	**Hazard Scenario Title**	Backhoe Dredger/ Construction craft has an allision with port infrastructure	**Risk ID**	C8

Risk Analysis	**Embedded Controls**	
Causes	**Controls**	**Comment**
Misjudgement of manoeuvre	Passage planning	
Adverse weather	Pilotage directions	
Equipment failure (on vessel)	Promulgation of current local weather	
Restricted/ Poor visibility	SOPs	Emergency plans including oil pollution response
Miscommunication	Appropriate towage	
Human error	Portable Pilot Unit	
Excessive vessel speed	Local Port Services	Managing movements
Project/ time pressure	Professional standards/ training	
	Project planning	Realistic time frames
	CDM regulations	
	Constructor RAMs	

WC Scenario	**ML Scenario**
Backhoe dredger operating in close proximity to quay side makes heavy contact with the port infrastructure, with the potential to result in: ▪ Serious injuries, ▪ £100,000 - £1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative national publicity. ABPmer estimate this to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.	Construction craft operating in close proximity to port infrastructure impacts the quayside, with the potential to result in: ▪ Minor injuries, ▪ £10,000 - £ 100,000 in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Minor local publicity. ABPmer estimate this to potentially occur once in every 10 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		**Embedded WC Consequence**			**Embedded ML Likelihood**		**Embedded ML Consequence**		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	3	Major			**Property**	2	Moderate
		Planet	3	Major			**Planet**	1	Minor
		Port	3	Major			**Port**	1	Minor

(Potential) Future additional controls	**Comment**	**Likelihood Mitigation**	**Consequence Mitigation**
Controls			
Special category risk assessments	Additional Safe Systems of Work	Low	Nil
Marine Liaison Officer		Low	Low
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low

Potential WC Likelihood		**Potential WC Consequence**			**Potential ML Likelihood**		**Potential ML Consequence**		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	3	Major			**Property**	2	Moderate
		Planet	3	Major			**Planet**	1	Minor
		Port	3	Major			**Port**	1	Minor

Risk Assessed by ABPmer in addition to the HAZID workshop

Table A9. Hazard Category: Stranding/ Grounding; Scenario: Commercial vessel delivering construction components grounds during transit into harbour; Risk ID C9

Hazard Category	Stranding/ Grounding	Hazard Scenario Title	Commercial vessel delivering construction components grounds during transit into harbour	Risk ID	C9

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
Human error	Hydrographic Survey	
Lapse in survey and maintenance dredging programme	Communication equipment and standards	
Inaccurate charting	Accurate tidal measurements	Tide level observed on-site and made available to vessels
Incorrect assessment of height of tide	Availability of latest hydrographic information	Survey provided in advance of the dredge
Communication failure	SOPs	Provided by the vessels owners/ operators
Misjudged manoeuvre	Availability of pollution response equipment	Shore side equipment provided by the Harbour Authority
	Port emergency plan	
	CDM regulations	
	Constructor RAMs	

WC Scenario	ML Scenario
Backhoe Dredger grounds on foul ground and becomes stranded requiring assistance to refloat, with the potential to result in: ▪ Serious injuries, ▪ £100,000 - £1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative local publicity. ABPmer estimate this to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.	Construction craft (e.g., barge) grounds temporarily whilst manoeuvring in close proximity to the shore, with the potential to result in: ▪ Minor injuries, ▪ £2,000 - £ 10,000 in property damage, ▪ No pollution, and ▪ Minor local publicity. ABPmer estimate this to potentially occur once in every 10 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	3	Major			**Property**	1	Minor
		Planet	3	Major			**Planet**	0	Negligible
		Port	2	Moderate			**Port**	1	Minor

(Potential) Future additional controls Controls	Comment	Likelihood Mitigation	Consequence Mitigation
Marine Liaison Officer	To provide safety information to vessels navigating in the area and to local authorities	Low	Low
Dedicated VHF channel		Low	Nil
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	3	Major			**Property**	1	Minor
		Planet	3	Major			**Planet**	0	Negligible
		Port	2	Moderate			**Port**	1	Minor

Risk Assessed by ABPmer in addition to the HAZID workshop

Table A10. Hazard Category: Collision; Scenario: Commercial vessel delivering construction components has a collision with another vessel during transit into harbour; Risk ID C10

Hazard Category	Collision	**Hazard Scenario Title**	Commercial vessel delivering construction components has a collision with another vessel during transit into harbour	**Risk ID**	C10

Risk Analysis	**Embedded Controls**	
Causes	**Controls**	**Comment**
Equipment failure (on vessel)	Pilotage directions	
Lack of situational awareness	Communication equipment and standards	VHF
Human error	Professional standards/ training	
Fatigue	Equipment maintenance	
Adverse weather	Passage planning	
Miscommunication	Appropriate towage	
Traffic management error – Port planning	General/ Special directions	
Failure to adhere to COLREGs	Local Port Services	Managing movements
Damage to construction critical cargo	COLREGs	
	SOPs	Emergency plans including oil pollution response
	CDM Regulations	
	Constructor RAMs	

WC Scenario	**ML Scenario**
Significant collision between the commercial vessel delivering construction components and a commercial vessel with the potential to result in: ▪ Single fatality, ▪ >£1 million in property damage, ▪ Tier 3 pollution event, and ▪ Negative international publicity. This was estimated to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.	A collision between the commercial vessel delivering and a commercial vessel at low speed following attempts to take avoiding action with the potential to result in: ▪ Minor injuries, ▪ £100,000 - £1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Minor local publicity. This was estimated to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		**Embedded WC Consequence**			**Embedded ML Likelihood**		**Embedded ML Consequence**		
Unlikely	2	**People**	3	Major	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	3	Major			**Planet**	1	Minor
		Port	3	Major			**Port**	1	Minor

(Potential) Future additional controls	**Comment**	**Likelihood Mitigation**	**Consequence Mitigation**
Control			
Additional towage		Low	Low
Notice to Mariners	Increased promulgation	Low	Nil
Marine management plan	Coordination/communication, deconfliction and contingency planning	Low	Low
Special category risk assessments	Additional Safe Systems of Work	Low	Nil
Wider communications	Social media	Low	Nil
Marine Liaison Officer		Low	Low

Potential WC Likelihood		**Potential WC Consequence**			**Potential ML Likelihood**		**Potential ML Consequence**		
Very Unlikely	1	**People**	3	Major	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	3	Major			**Planet**	1	Minor
		Port	3	Major			**Port**	1	Minor

Risk Assessed by ABPmer in addition to the HAZID workshop

Table A11. Hazard Category: Allision/ Contact; Scenario: Commercial vessel delivering construction components has an allision with port infrastructure on approach; Risk ID C11

Hazard Category	Allision/ Contact	Hazard Scenario Title	Commercial vessel delivering construction components has an allision with port infrastructure on approach	Risk ID	C11

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
Misjudged manoeuvre	Passage planning	
Adverse weather (Beam Wind)	Pilotage directions	
Equipment failure (on vessel)	Appropriate towage	
Restricted/ Poor visibility	Portable Pilot Unit	
Miscommunication (Master/ Pilot)	Professional standards/ training	
Change in navigational environment	SOPs	Emergency plans including oil pollution
Damage to construction critical cargo		

WC Scenario	ML Scenario
The commercial vessel delivering construction components has an allision with port infrastructure on approach, damaging works that have already occurred, with the potential to result in: ▪ Serious injuries, ▪ >£1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative national publicity. This was estimated to potentially occur once in every 25 years whilst operations occur, at the embedded stage.	The commercial vessel delivering construction components make contact with a section of the port that has not yet been redeveloped, with the potential to result in: ▪ Minor injuries, ▪ £100,000 - £1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Minor local publicity. This was estimated to potentially occur once in every 25 years whilst operations occur, at the embedded stage.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Unlikely	2	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	3	Major			**Planet**	1	Minor
		Port	3	Major			**Port**	1	Minor

(Potential) Future additional controls	Comment	Likelihood Mitigation	Consequence Mitigation
Controls			
New/ Additional AtoN		Low	Nil
Reduced usage of Duchy/ County for larger vessels	Also reduces wash in vicinity of marina	Medium	Nil
Scheme proposed dredge area	Increases navigable water	Low	Nil
Additional towage	Increased power/ capacity	Medium	Medium
Dynamic under keel clearance	Navigation aid	Low	Nil
Special category risk assessments	Additional Safe Systems of Work	Low	Nil

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	1	Minor	Very Unlikely	1	**People**	1	Minor
		Property	3	Major			**Property**	2	Moderate
		Planet	2	Moderate			**Planet**	1	Minor
		Port	2	Moderate			**Port**	1	Minor

Risk Assessed by ABPmer in addition to the HAZID workshop

Table A12. Hazard Category: Payload Related Incident; Scenario: Spud leg barge/ Dumb barge and tow/ Self-propelled Construction Craft have payload related incident; Risk ID C12

Hazard Category	Payload Related Incident	**Hazard Scenario Title**	Spud leg barge/ Dumb barge and tow/ Self-propelled Construction Craft have payload related incident	**Risk ID**	C12

Risk Analysis	**Embedded Controls**	
Causes	**Controls**	**Comment**
Failure of a spud leg	Safe Systems Of Work (H&S)	
Unbalanced load	SOPs	Provided by the vessels owners/ operators
Excessive load	Loading/ unloading plan	Provided by the vessels owners/ operators
Equipment failure	Vessel maintenance	Maintenance schedule part of the vessel SMS
	Port emergency plan	
	Training of port marine/ operations personnel	

WC Scenario	**ML Scenario**
Spud barge leg fails causing the craft to lose balance and list, with the potential to result in: ▪ Serious injuries, ▪ £100,000 to £1 million in property damage, ▪ Tier 1 pollution event, and ▪ Negative national publicity. ABPmer estimate this to potentially occur once in every 25 years if construction occurred continuously throughout the period with embedded controls only.	Construction Craft is loaded unevenly and lists, with the potential to result in: ▪ Minor injuries, ▪ £0 - £2,000 in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Nil reputational impact. ABPmer estimate this to potentially occur once in every 5 years if construction occurred continuously throughout the period with embedded controls only.

Embedded WC Likelihood		**Embedded WC Consequence**			**Embedded ML Likelihood**		**Embedded ML Consequence**		
Unlikely	2	**People**	2	Moderate	Probable	4	**People**	1	Minor
		Property	3	Major			**Property**	0	Negligible
		Planet	2	Moderate			**Planet**	1	Minor
		Port	3	Major			**Port**	0	Negligible

(Potential) Future additional controls	**Comment**	**Likelihood Mitigation**	**Consequence Mitigation**
Controls			
Marine Liaison Officer	To provide safety information to vessels navigating in the area and to local authorities	Low	Low
Contractor risk assessment method statement (RAMS)	Method statement identifies unloading process for heavy loads to minimise vessel instability	Low	Nil
Marine management plan	Coordination/ communication, deconfliction and contingency planning	Low	Low

Potential WC Likelihood		**Potential WC Consequence**			**Potential ML Likelihood**		**Potential ML Consequence**		
Unlikely	2	**People**	2	Moderate	Probable	4	**People**	1	Minor
		Property	3	Major			**Property**	0	Negligible
		Planet	2	Moderate			**Planet**	1	Minor
		Port	3	Major			**Port**	0	Negligible

Risk Assessed by ABPmer in addition to the HAZID workshop

B Navigational Risk Assessment: Operation

Table B1. Hazard Category: Allision/ Contact; Scenario: Large cruise vessel (250-350m) contact with port infrastructure; Risk ID O1

Hazard Category	Allision/ Contact	Hazard Scenario Title	Large cruise vessel (250-350m) contact with port infrastructure	Risk ID	O1

Risk Analysis: Causes	Embedded Controls: Controls	Embedded Controls: Comment
Misjudged manoeuvre	Passage planning	
Adverse weather (Beam Wind)	Pilotage directions	
Equipment failure (on vessel)	Promulgation of current local weather	
Visibility - hours of darkness	SOPs	Emergency plans including oil pollution response
Miscommunication (Master/ Pilot)	Appropriate towage	
Conning position change failure – (Bridgewing control)	Portable Pilot Unit	
	Local Port Services	Managing movements
	Professional standards/ training	

WC Scenario	ML Scenario
A large cruise ship makes heavy contact with the port infrastructure causing significant damage to the ship and the pier, with potential to result in: ▪ Serious injuries, ▪ >£1 million in property damage, ▪ Tier 3 pollution event, and ▪ Negative international publicity. This was estimated to potentially occur once in every 50 years whilst operations occur with embedded controls only.	A large cruise ship has makes greater than expected contact with the pier with the with the potential to result in: ▪ Minor injuries, ▪ £10,000 - £100,000 on property damage, ▪ No pollution, and ▪ Negative local publicity. This was estimated to potentially occur once in every 10 years whilst operations occur, at the embedded stage.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Very Unlikely	1	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	4	Extreme			**Property**	2	Moderate
		Planet	4	Extreme			**Planet**	0	Negligible
		Port	4	Extreme			**Port**	2	Moderate

(Potential) Future additional controls: Controls	Comment	Likelihood Mitigation	Consequence Mitigation
Additional Portable Pilot Unit	Redundancy	Low	Nil
Wharf design	Layout and orientation	Medium	Nil
Specific ship type training for pilots	Additional training	Medium	Nil
Simulation	Additional training	Medium	Nil
Aids to navigation	Virtual AtoN/ AIS beacons	Low	Nil
Additional towage	Increased power/ capacity	Medium	Medium
Special category risk assessments	Additional Safe Systems of Work	Low	Nil

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	1	Minor	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	2	Moderate
		Planet	4	Extreme			**Planet**	0	Negligible
		Port	4	Extreme			**Port**	2	Moderate

Table B2. Hazard Category: Allision/ Contact; Scenario: Allision between a commercial vessel and Queen's Wharf extension; Risk ID O2

Hazard Category	Allision/ Contact	Hazard Scenario Title	Allision between a commercial vessel and Queen's Wharf extension	Risk ID	O2

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
Misjudged manoeuvre	Passage planning	
Adverse weather (Beam Wind)	Pilotage directions	
Equipment failure (on vessel)	Appropriate towage	
Visibility - hours of darkness	Portable Pilot Unit	
Miscommunication (Master/ Pilot)	Professional standards/ training	
Change in navigational environment	SOPs	Emergency plans including oil pollution response

WC Scenario	ML Scenario
A commercial vessel departing Duchy/ County has an allision with the extension of Queen's Wharf, with the potential to result in: ▪ Serious injuries, ▪ >£1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative international publicity. This was estimated to potentially occur once in every 25 years whilst operations occur, at the embedded stage.	A commercial vessel departing Duchy/County makes contact as it rounds the extension of Queen's Wharf with the potential to result in: ▪ Minor injuries, ▪ £100,000 - £1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Nil reputational damage. This was estimated to potentially occur once in every 25 years whilst operations occur, at the embedded stage.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Unlikely	2	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	3	Major			**Planet**	1	Minor
		Port	4	Extreme			**Port**	0	Negligible

(Potential) Future additional controls	Comment	Likelihood Mitigation	Consequence Mitigation
Controls			
New/ Additional AtoN		Low	Nil
Reduced usage of Duchy/ County for larger vessels	Also reduces wash in vicinity of marina	Medium	Nil
Scheme proposed dredge area	Increases navigable water	Low	Nil
Additional towage	Increased power/ capacity	Medium	Medium
Dynamic under keel clearance	Navigation aid	Low	Nil
Special category risk assessments	Additional Safe Systems of Work	Low	Nil

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	1	Minor	Very Unlikely	1	**People**	1	Minor
		Property	3	Major			**Property**	2	Moderate
		Planet	2	Moderate			**Planet**	1	Minor
		Port	3	Major			**Port**	0	Negligible

Table B3. Hazard Category: Contact; Scenario Vessel leaving drydock makes contact with moored cruise vessel; Risk ID O3

Hazard Category	Collision	Hazard Scenario Title	Vessel leaving drydock makes contact with moored cruise vessel	Risk ID	O3

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
Equipment failure (on vessel)	Local Port Services	Port scheduling/ management
Adverse weather	Appropriate towage	
Tug failure	Communication equipment and standards	VHF
Reduced navigable water	COLREGs	
Human error	SOPs	Emergency plans including oil pollution response
Failure to adhere to COLREGs		

WC Scenario	ML Scenario
Vessel departing the dry dock has a significant collision (impact) with a cruise ship moored near the dry dock's entrance, with the potential to result in: ▪ A single fatality, ▪ >£1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative international publicity. This was estimated to potentially occur once in every 25 years whilst operations occur, at the embedded stage.	Vessel departing the dry dock has a minor collision (scraping) with a cruise ship moored near the dry dock's entrance with the potential to result in: ▪ Minor injuries, ▪ £10,000 - £100,000 on property damage, ▪ No pollution, and ▪ Negative local publicity. This was estimated to potentially occur once in every 10 years whilst operations occur, at the embedded stage.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Unlikely	2	**People**	3	Major	Occasionally	3	**People**	1	Minor
		Property	4	Extreme			**Property**	2	Moderate
		Planet	3	Major			**Planet**	0	Negligible
		Port	4	Extreme			**Port**	2	Moderate

(Potential) Future additional controls Controls	Comment	Likelihood Mitigation	Consequence Mitigation
Alternate berthing options	Deconflict movement with berth use	Medium	Nil
Safety boat	Workboat operation procedures	Low	Nil
Vessel functionality test	Prior to vessel departing dry dock	Low	Nil
Weather restrictions	Develop specific weather restrictions	Low	Nil

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	3	Major	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	2	Moderate
		Planet	3	Major			**Planet**	0	Negligible
		Port	4	Extreme			**Port**	2	Moderate

Table B4. Hazard Category: Allision/ Collision; Scenario: Allision between Dead Tow / abnormal indivisible load (inc. FLOW) and port infrastructure / contact with berthed vessel; Risk ID O4

Hazard Category	Allision/ Contact	**Hazard Scenario Title**	Allision between Dead Tow / abnormal indivisible load (inc. FLOW) and port infrastructure / contact with berthed vessel	**Risk ID**	O4

Risk Analysis	**Embedded Controls**	
Causes	**Controls**	**Comment**
Misjudged manoeuvre	Passage planning	
Adverse weather	Pilotage directions	
Tug failure	Appropriate towage	
Traffic density	Portable Pilot Unit	
Miscommunication (Master/ Pilot)	Escort vessels	Safety boats
Poor traffic management	SOPs	Emergency plans including oil pollution response
towage breakout/ lines failing		

WC Scenario	**ML Scenario**
An allision occurs between the abnormal/ indivisible tow (inc. FLOW turbine)and port infrastructure during transit from port sea, with the potential to result in: ▪ A single fatality, ▪ >£1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative international publicity. This was estimated to potentially occur once in every 25 years whilst operations occur, at the embedded stage.	Contact occurs between the abnormal/ indivisible tow (inc. FLOW turbine), or an associated vessel (tug/ safety boat) and a vessel berthed with the potential to result in: ▪ Minor Injuries, ▪ >£1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Negative local publicity. This was estimated to potentially occur once in every 10 years whilst operations occur, at the embedded stage.

Embedded WC Likelihood		**Embedded WC Consequence**			**Embedded ML Likelihood**		**Embedded ML Consequence**		
Unlikely	2	**People**	3	Major	Occasionally	3	**People**	1	Minor
		Property	4	Extreme			**Property**	4	Extreme
		Planet	3	Major			**Planet**	1	Minor
		Port	4	Extreme			**Port**	2	Moderate

(Potential) Future additional controls	**Comment**	**Likelihood Mitigation**	**Consequence Mitigation**
Controls			
Simulation	Training	Low	Nil
Layby emergency berth	Emergency berth set up for transit	Nil	Medium
Scheme design	Dredge pocket/ port layout	Medium	Nil
Mooring design parameters	Specific considerations	Low	Nil
Special category risk assessments	Additional Safe Systems Of Work (Tugs)	Low	Nil

Potential WC Likelihood		**Potential WC Consequence**			**Potential ML Likelihood**		**Potential ML Consequence**		
Very Unlikely	1	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	4	Extreme
		Planet	3	Major			**Planet**	1	Minor
		Port	4	Extreme			**Port**	2	Moderate

Table B5. Hazard Category: Other (Towage Breakout); Scenario: Dead Tow / abnormal indivisible load (inc. FLOW) breaks free from its tow; Risk ID O5

Hazard Category	Other (Towage Breakout)	Hazard Scenario Title	Dead Tow / abnormal indivisible load (inc. FLOW) breaks free from its tow	Risk ID	O5

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
Misjudged manoeuvre	Passage planning	
Adverse weather (wind)	Pilotage directions	
Tug failure	Appropriate towage	
Miscommunication (Master/ Pilot/Tug)	Non-routine towage process	
Towage breakout/ lines failing	Escort vessels	Safety boats
	SOPs	Emergency plans including towage breakaway
	Interface of respective MSMS for respective SHAs	
	MetOcean prediction, weather downtime review	

WC Scenario	ML Scenario
Abnormal tow breaks free from its towing bridal and drifts freely, with the potential to result in: ▪ A single fatality, ▪ >£1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Negative international publicity. This was estimated to potentially occur once in every 25 years whilst operations occur, at the embedded stage.	Abnormal tow suffers a broken towing line but remains attached to other elements of the tow, with the potential to result in: ▪ Serious Injuries, ▪ £100,000 - £1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Negative local publicity. This was estimated to potentially occur once in every 10 years whilst operations occur, at the embedded stage.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Unlikely	2	**People**	3	Major	Occasionally	3	**People**	2	Moderate
		Property	4	Extreme			**Property**	3	Major
		Planet	1	Minor			**Planet**	1	Minor
		Port	4	Extreme			**Port**	2	Moderate

(Potential) Future additional controls	Comment	Likelihood Mitigation	Consequence Mitigation
Controls			
Simulation	Training	Low	Nil
Layby emergency berth	Emergency berth set up for transit	Nil	Medium
Towage Plan, approved by FHC and FDEC for passage through respective SHAs		Medium	Nil
Mooring design parameters	Specific considerations	Low	Nil
Special category risk assessments	Additional Safe Systems Of Work (Tugs)	Low	Nil

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	1	Minor			**Planet**	1	Minor
		Port	4	Extreme			**Port**	2	Moderate

Table B6. Hazard Category: Collision; Scenario: Dead Tow/ abnormal indivisible load (inc. FLOW) collides with another vessel; Risk ID O6

Hazard Category	Collision	Hazard Scenario Title	Dead Tow/ abnormal indivisible load (inc. FLOW) collides with another vessel	Risk ID	O6

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
Misjudged manoeuvre	Passage planning	
Adverse weather (wind)	Pilotage directions	
Tug failure	Appropriate towage	
Miscommunication (Master/ Pilot/Tug)	Non-routine towage process	
Towage breakout/ lines failing	Escort vessels	Safety boats
Poor traffic management	SOPs	Emergency plans including towage breakaway
	Interface of respective MSMS for respective SHAs	
	MetOcean prediction, weather downtime review	
	Local Port Services	No other commercial movements

WC Scenario	ML Scenario
Abnormal tow collides with another ship underway, with the potential to result in: ▪ A single fatality, ▪ >£1 million in property damage, ▪ Tier 2 pollution event, and ▪ Negative international publicity. This was estimated to potentially occur once in every 50 years whilst operations occur, at the embedded stage.	The tug associated with an abnormal tow collides with a recreational vessel, with the potential to result in: ▪ Serious Injuries, ▪ £10,000 - £100,000 in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Negative local publicity. This was estimated to potentially occur once in every 10 years whilst operations occur, at the embedded stage.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Very Unlikely	1	**People**	3	Major	Occasionally	3	**People**	2	Moderate
		Property	4	Extreme			**Property**	2	Moderate
		Planet	3	Major			**Planet**	1	Minor
		Port	4	Extreme			**Port**	2	Moderate

(Potential) Future additional controls	Comment	Likelihood Mitigation	Consequence Mitigation
Controls			
Simulation	Training	Low	Nil
Special category risk assessments	Additional Safe Systems Of Work (Tugs)	Low	Nil
Towage Plan, approved by FHC and FDEC for passage through respective SHAs		Medium	Nil
Exclusion zone		Low	Nil

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	3	Major			**Planet**	1	Minor
		Port	4	Extreme			**Port**	2	Moderate

Table B7. Hazard Category: Stranding/ Grounding; Scenario: Dead Tow/ abnormal indivisible load (inc. FLOW) grounds during transit between FDEC and sea; Risk ID O7

Hazard Category	Stranding/ Grounding	Hazard Scenario Title	Dead Tow/ abnormal indivisible load (inc. FLOW) grounds during transit between FDEC and sea	Risk ID	O7

Risk Analysis	Embedded Controls	
Causes	**Controls**	**Comment**
Misjudged manoeuvre	Passage planning	
Adverse weather (wind)	Pilotage directions	
Tug failure	Appropriate towage	
Miscommunication (Master/ Pilot/Tug)	Non-routine towage process	
Towage breakout/ lines failing	Escort vessels	Safety boats
	SOPs	Emergency plans including towage breakaway
	Interface of respective MSMS for respective SHAs	
	MetOcean prediction, weather downtime review	
	Hydrographic Survey	
	Accurate tidal measurements	
	Availability of latest hydrographic information	

WC Scenario	ML Scenario
Abnormal/ indivisible load becomes stranded whilst transiting through the Fal Estuary , with the potential to result in: ▪ Serious injuries, ▪ >£1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Negative international publicity. This was estimated to potentially occur once in every 25 years whilst operations occur, at the embedded stage.	Abnormal/ indivisible load grounds whilst transiting through the Fal Estuary and is able to be floated off on the next rising tide, with the potential to result in: ▪ Minor Injuries, ▪ £100,000 - £1 million in property damage, ▪ Minor pollution, Tier 1 with no measurable impact, and ▪ Negative national publicity. This was estimated to potentially occur once in every 10 years whilst operations occur, at the embedded stage.

Embedded WC Likelihood		Embedded WC Consequence			Embedded ML Likelihood		Embedded ML Consequence		
Unlikely	2	**People**	2	Moderate	Occasionally	3	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	1	Minor			**Planet**	1	Minor
		Port	4	Extreme			**Port**	3	Major

(Potential) Future additional controls	Comment	Likelihood Mitigation	Consequence Mitigation
Controls			
Simulation	Training	Low	Nil
Special category risk assessments	Additional Safe Systems Of Work (Tugs)	Low	Nil
Towage Plan, approved by FHC and FDEC for passage through respective SHAs		Medium	Nil
Mooring design parameters	Specific considerations	Low	Nil

Potential WC Likelihood		Potential WC Consequence			Potential ML Likelihood		Potential ML Consequence		
Very Unlikely	1	**People**	2	Moderate	Unlikely	2	**People**	1	Minor
		Property	4	Extreme			**Property**	3	Major
		Planet	1	Minor			**Planet**	1	Minor
		Port	4	Extreme			**Port**	3	Major

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