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Morlais Menter Môn

Navigation Risk Assessment – Morlais Tidal Demonstration Zone

Applicant: Menter Môn Limited

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EXECUTIVE SUMMARY

Marine and Risk Consultants Ltd (Marico Marine) has undertaken a Navigation Risk Assessment to assess the impact of the construction and operation of the Morlais Tidal Demonstration Project, west of Holy Island, Anglesey, 500m off South Stack. The Morlais Zone occupies a total area of 35 sq.km and has been sub-divided in to 8 sub-zones.

A Navigational Risk Assessment compliant to the Maritime and Coastguard Agency's Marine Guidance Note (MGN) 543 was undertaken in order to assess the impact on navigational safety, and to identify any recommendations as required. The project has been assessed utilising the Rochdale Envelope approach and, therefore, assumes a range of possible devices with the potential for utilisation of one of, or a combination of; sea-bed mounted, mid-water or surface devices.

A baseline assessment was undertaken including the analysis of vessel traffic data from the Automatic Identification System, RADAR and a variety of secondary sources. Traffic density within the Morlais Zone was identified to be generally low. The greatest density of traffic is to the north and east of the test site and is chiefly associated with ferry and small, particularly recreational vessel, transits within the inshore passage respectively.

A review of incident data from the Marine Accident Investigation Branch (1997 to 2017) identified 14 separate MAIB incidents within 1nm, of the Morlais Zone of which, one was considered navigationally significant; a collision between a recreational motor boat and a dive boat on 31st August 2015.

46 individual hazards were identified and individually assessed. These hazards were assessed according to two distinct project phases; operation and construction. The assessment considered the following baseline assumptions:

- Utilisation of worst-case maximum capacity (240MW);
- Any device type may be deployed within any sub-zone;
- Maximum 9 x 33 kv export cables;
- Rochdale Envelope Approach; and
- All embedded mitigation measures in place prior to construction commencing.

The majority of hazards were scored to be low-risk, however, 11 and 15 hazards respectively scored higher than 4 (low risk) for the construction and operation

phases with one hazard; Grounding Recreational Vessel, scored as significant for both phases, driven by the reduction in sea room as a result of the narrowing of the inshore passage. The following mitigation measures were, therefore, identified for consideration to reduce this hazard to ALARP:

- Devices >8m below CD to be deployed along the eastern boundary; or
- Redesign eastern boundary.

Two critical depths were established through consultation in order to ensure continued safe navigation through the Morlais Zone:

- A minimum 8m UKC would be required to ensure continued safe navigation of vessels draught <3m through the Morlais Zone;
- A minimum UKC of 20m would be required to ensure continued safe navigation of ferries and vessels draught >3m through the Morlais Zones. Where this is not possible, alternative routes, including ferry poor weather routes should be provided to ensure safe passage during adverse weather conditions.

Although scored as ALARP (5.13) driven by a low environmental and vessel consequence score it is considered that the hazard *'Snagging/ Obstruction: Fishing Vessel: A fishing vessel's gear/ anchor interacts with a cable or the device and its moorings'* cannot be mitigated to a level that would reduce the risk to people and the project to acceptable levels and, as such, it is recommended that fishing be excluded within the Morlais Zone.

A full list of possible additional mitigation measures is given below:

POSSIBLE ADDITIONAL RISK CONTROL MEASURES.

ID	Risk Control	Phase	
		Construction	Operation
1	Continuous Monitoring by Marine Co-ordination Centre	X	X
2	Restrict Navigation through the Morlais Zone	X	X
3	Exclusion of fishing within the Morlais Zone	X	X
4	Devices >8m below CD to be deployed along eastern boundary		X
5	Devices >20m to be deployed within Zones 1,2 and 8		X
6	Re-design eastern boundary		X
7	Appropriate alignment and spacing of devices		X
8	Check device surveys		X
9	Guard vessel to monitor passing traffic	X	

ID	Risk Control	Phase	
		Construction	Operation
10	Establish no anchoring areas	X	X
11	Enhanced cable protection	X	X
13	Implementation of Safety Zones	X	
14	Construction vessels to be marked in accordance with COLREGS	X	
15	Temporary navigation aids as required by Trinity House	X	
18	Undertake Device Specific Risk Assessments		X

Continuous review of the navigation risk assessment to ensure that it remains up to date and fit-for-purpose is advised in line with MGN 543. The NRA process should be an on-going process throughout the life of the project taking into account changes in traffic densities and other factors that may affect the hazard regime. Site and device specific assessments should be undertaken to assess the proposed locations of; individual turbine devices, substations, platforms and any other associated structures.

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ABBREVIATIONS

Abbreviation	Detail
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
ASD	Admiralty Sailing Directions
ATBA	Area To Be Avoided
CD	Chart Datum
CGOC	Coast Guard Operation Centre
CHA	Competent Harbour Authority
COLREGS	International Regulations for Preventing Collisions at Sea
DfT	Department for Transport
ERCoP	Emergency Response Co-operation Plan
ES	Environmental Statement
FLO	Fisheries Liaison Officer
FSA	Formal Safety Assessment
GIS	Geographic Information System
HA	Harbour Authority
HMCG	Her Majesty's Coast Guard
HSC	High Speed Craft
HSE	Health & Safety Executive
HW	High Water
IALA ASM	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICW	In Collision With
IMO	International Maritime Organisation
IMM	International Maritime Management
ISM	International Safety Management
kt	Knot (unit of speed equal to nautical mile per hour, approximately 1.15 mph)
kWh	Kilowatt-hour
LOA	Length-Over All
LW	Low Water
m	Metre
MAIB	Maritime Accident Investigation Branch
Marico Marine	Marine and Risk Consultants Ltd
MCA	Maritime and Coastguard Agency

Abbreviation	Detail
MGN	Marine Guidance Note
ML	Most Likely
MMO	Marine Management Organisation
MSI	Maritime Safety Information
nm	Nautical Mile
NRA	Navigation Risk Assessment
NSMS	Navigational Safety Management System
NTM	Notice To Mariners
OREI	Offshore Renewable Energy Infrastructure
PA	Precautionary Area
PEXA	Practise and Exercise Area
PHA	Preliminary Hazard Analysis
PPE	Personal Protective Equipment
RHIB	Rigid Hull Inflatable Boat
RNLI	Royal National Lifeboat Institution
RYA	Royal Yachting Association
SAR	Search and Rescue
SHA	Statutory Harbour Authority
SMS	Safety Management System
SOG	Speed Over Ground
SOLAS	Safety Of Life At Sea
SRR	Search and Rescue Region
THLS	Trinity House Lighthouse Service
TSS	Traffic Separation Schemes
UKC	Under Keel Clearance
VHF	Very High Frequency (radio communication)
VMS	Vessel Monitoring System
WC	Worst Credible

1. INTRODUCTION

Menter Môn has requested Marine and Risk Consultants Ltd (Marico Marine) undertake a Navigation Risk Assessment (NRA) to assess the impact of the construction and operation of the Morlais Tidal Demonstration Project, off Anglesey, to existing navigation.

The NRA was conducted based on the Formal Safety Assessment (FSA)¹ approach to risk management utilising data analysis and stakeholder/expert judgement to determine risk levels.

The project has been assessed utilising the Rochdale Envelope approach² and, therefore, considers the installation of a range of device types within the Morlais Zone.

1.1 SCOPE AND METHODOLOGY

The scope and objectives of this assessment are as follows:

1. Describe the project;
2. Provide a description of the existing baseline environment and activities in the project area, including but not limited to:
 - a. Local ports and harbours;
 - b. Tidal conditions;
 - c. Other users of the area such as aggregates, oil and gas, anchorages, military and renewable energy installations;
 - d. Existing vessel traffic patterns, including frequency and types; and
 - e. Existing risk profile for navigational incidents.
3. Identify and assess impacts of the development to shipping and navigation, including:
 - a. Traffic routeing;
 - b. Collision risk;
 - c. Cable risk;
 - d. Communications, Radar and Positioning Systems;
 - e. Search and Rescue; and
 - f. Cumulative and In-Combination Effects.

¹ IMO (2018) Revised Guidelines for Formal Safety Assessment (FSA) MSC-MEPC.2/Circ.12/Rev.2

² Planning Inspectorate (2018) 'Advice Note 9: Rochdale Approach

4. Undertake an NRA that identifies the hazards during the construction and operation phases of the development. These hazards are then assessed, and risk controls identified to reduce the risk to an acceptable threshold; and
5. Make recommendations as to the safety of the development and what measures should be implemented to improve it.

2 DESCRIPTION OF SITE

2.1 STUDY AREA

The location of the Morlais Zone is given within **Figure 1**. The Morlais Zone is located to the west of Holy Island, Anglesey, 500m off South Stack. The Morlais Zone occupies a total area of 35 sq.km and has been sub-divided in to 8 sub-zones. The project has a 45-year lease, which commenced in 2014, and a 25-year design life.

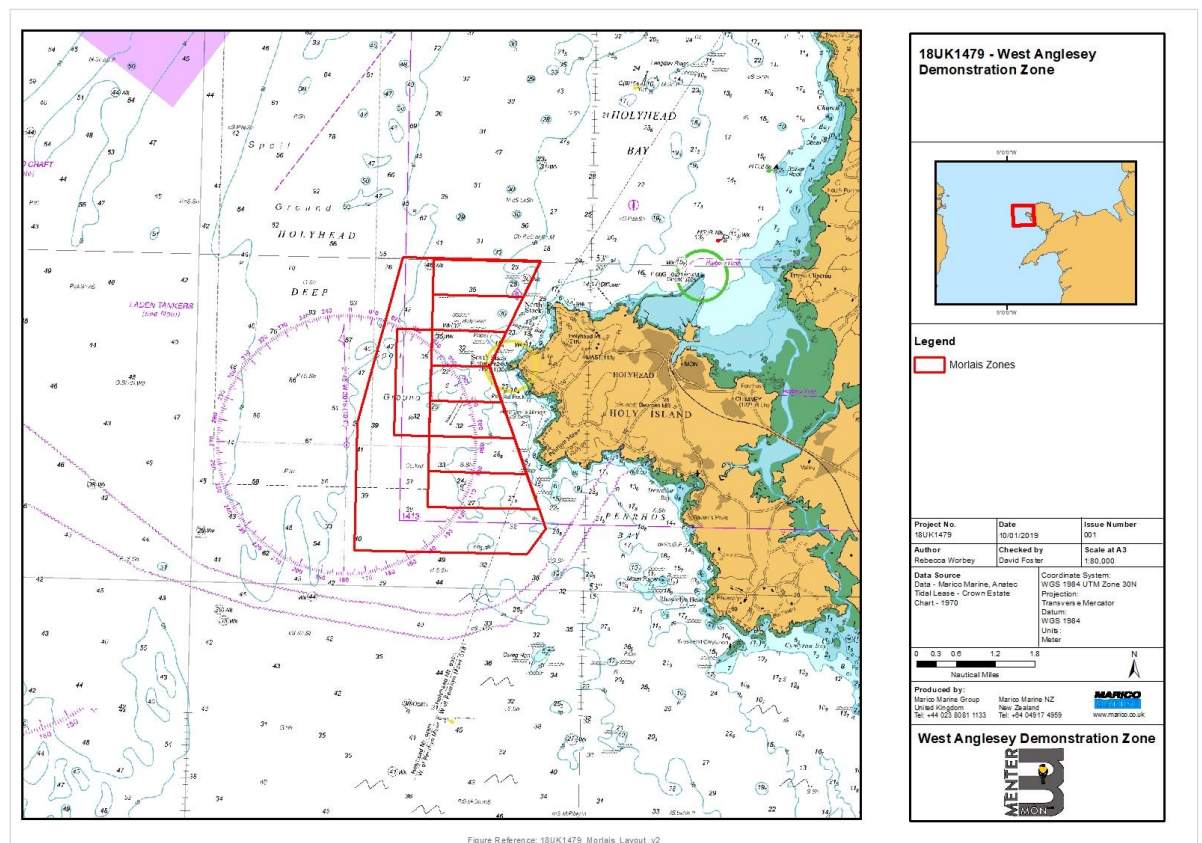


FIGURE 1: PROPOSED MORLAIS ZONE LOCATION

2.2 BACKGROUND



The Morlais Tidal Demonstration project aims to generate renewable energy from the strong tidal flows around Anglesey. The project has an aspirational maximum capacity of 240 MW over a 20-hour a day operating window. Installation is planned to take place between 2022 and 2023.

The Morlais Zone has been subdivided into 8 sub-zones with the potential for up to 8 developers to secure access to berths. Subsequently, the types of turbines to be deployed have not yet been determined with the potential for utilisation of one of, or a combination of; sea-bed mounted, mid-water or surface devices.



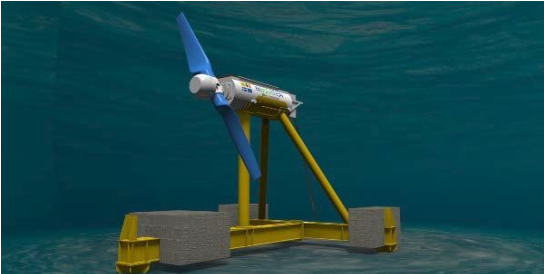
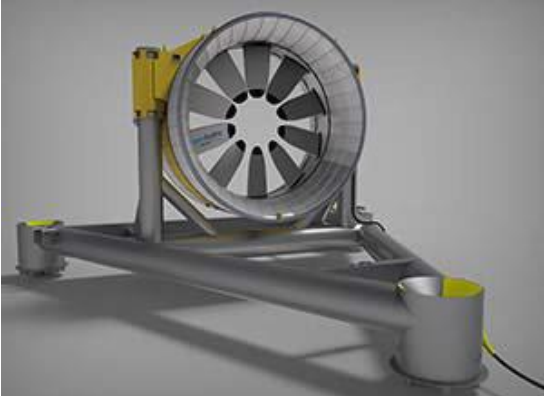
2.3 PROPOSED TIDAL DEVICES

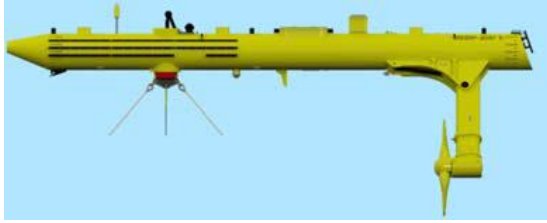
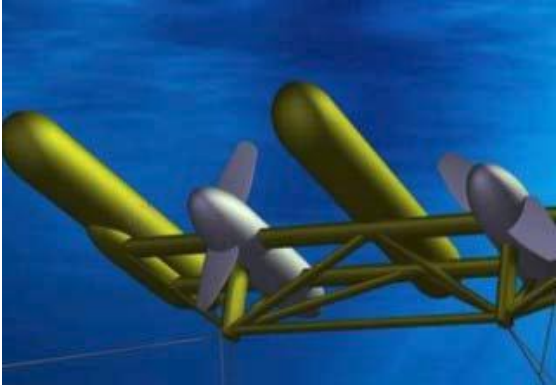
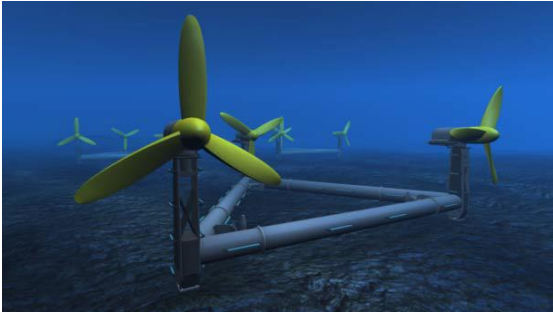

A range of example devices that could be deployed within the Morlais Zone are given within **Table 2-1**.

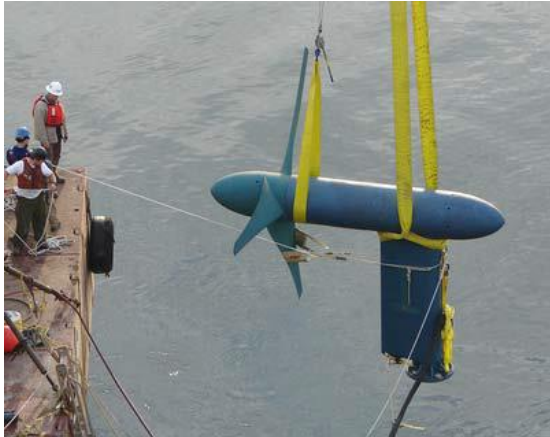
TABLE 2-1: EXAMPLES OF TIDAL ENERGY CONVERTERS (TEC) THAT COULD BE DEPLOYED IN THE MORLAIS ZONE³

Device	Detail
<p>Andritz Hydro Hammerfest</p> 	<p>The Andritz Hydro Hammerfest device is a horizontal axis turbine, 3 blade rotor with full pitch control. The device is fully submerged on a gravity foundation. The turbine has a modular design, allowing all critical components to be lifted out of the water in one operation for maintenance and repair.</p>
<p>Atlantis AR series</p> 	<p>The AR series turbines are commercial scale horizontal axis turbines designed for open ocean deployment. AR turbines feature a twin rotor set with fixed pitch blades.</p>

³ PB5034_MTA_Scoping_Report_Final(Apr_18)_NRW

Device	Detail
<p data-bbox="491 248 743 277">Aquantis AQ Series</p> 	<p data-bbox="940 248 1476 376">The AQ series turbines are driven by an upstream rotor with variable pitch blades, with the rotor sweep well below the surface.</p>
<p data-bbox="344 607 890 674">Instream Energy Systems Vertical Access Hydrokinetic</p>  <p data-bbox="512 1043 722 1072">Turbine (VAHT)</p>	<p data-bbox="940 607 1476 741">The VAHT is a non-submerged hydrokinetic power solution consisting, applicable in both inland water and near-shore tidal applications.</p>
<p data-bbox="360 1088 874 1120">Nova Innovation 30 and M100 Turbines</p> 	<p data-bbox="940 1088 1476 1189">The Nova M100 turbine is scalable and suitable for deployment in a range of deep water, estuarine and river environments.</p>
<p data-bbox="352 1424 882 1456">Open Hydro Open Centre Turbine (OCT)</p> 	<p data-bbox="940 1424 1476 1585">The Open Hydro device is an open centre turbine: a horizontal axis turbine with two counter rotating fixed pitch rotors and direct drive, with permanent magnetic DC rim generators.</p> <p data-bbox="940 1603 1476 1765">The turbine is designed to be deployed directly on the seabed, using a gravity foundation and a purpose build barge. The rotors are fabricated largely from glass reinforced composites.</p>
<p data-bbox="435 1883 801 1915">Orbital Marine Tidal Turbine</p>	<p data-bbox="940 1883 1476 2011">The Orbital Marine Tidal Turbine device is a floating device which has two horizontal axis turbines mounted beneath the surface on a floating hull platform.</p>

Device	Detail
	<p>The turbine blades can be retracted beneath the hull for maintenance purposes. The platform is moored to the seabed via 4 seabed anchor points. A power and control umbilical line connects the device to control and grid.</p>
<p>SME Plat-O</p> 	<p>The SME Plat-O device is a mid-water column floating platform that allows multiple turbines to be mounted.</p>
<p>Tidal Energy Limited (TEL) – Delta Stream</p> 	<p>The Delta Stream device consists of an array of 3 horizontal axis rotors mounted on a frame/platform resting on the seabed.</p> <p>Three turbines on a single, circa 30m wide, triangular frame have a low centre of gravity giving structural stability.</p>
<p>Tidal Stream Ltd Triton</p> 	<p>The Triton device is a low lying, surface piercing device with a buoyant superstructure attached to seabed, with monopile, pin piles or gravity structure utilising mooring lines or a rigid structure. Can support multiple TECs on a single platform.</p>

Device	Detail
<p>Verdant Isles Kinetic Hydropower System (KHPS)</p> 	<p>Verdant Power's KHPS incorporates turbines with open three bladed rotors installed fully under water. The turbine is designed to self-rotate into the prevailing current so that the blades are optimally aligned to generate energy.</p>

It should be noted that a finalised device specific layout was not available for the assessment. As such, the NRA assumes any combination of device types may be deployed up to a maximum 240MW (worst case) capacity (See **Section 9**). **Figure 2** provides an example worst case layout should up to 2040MW of surface floating devices be deployed throughout the Morlais Zone.

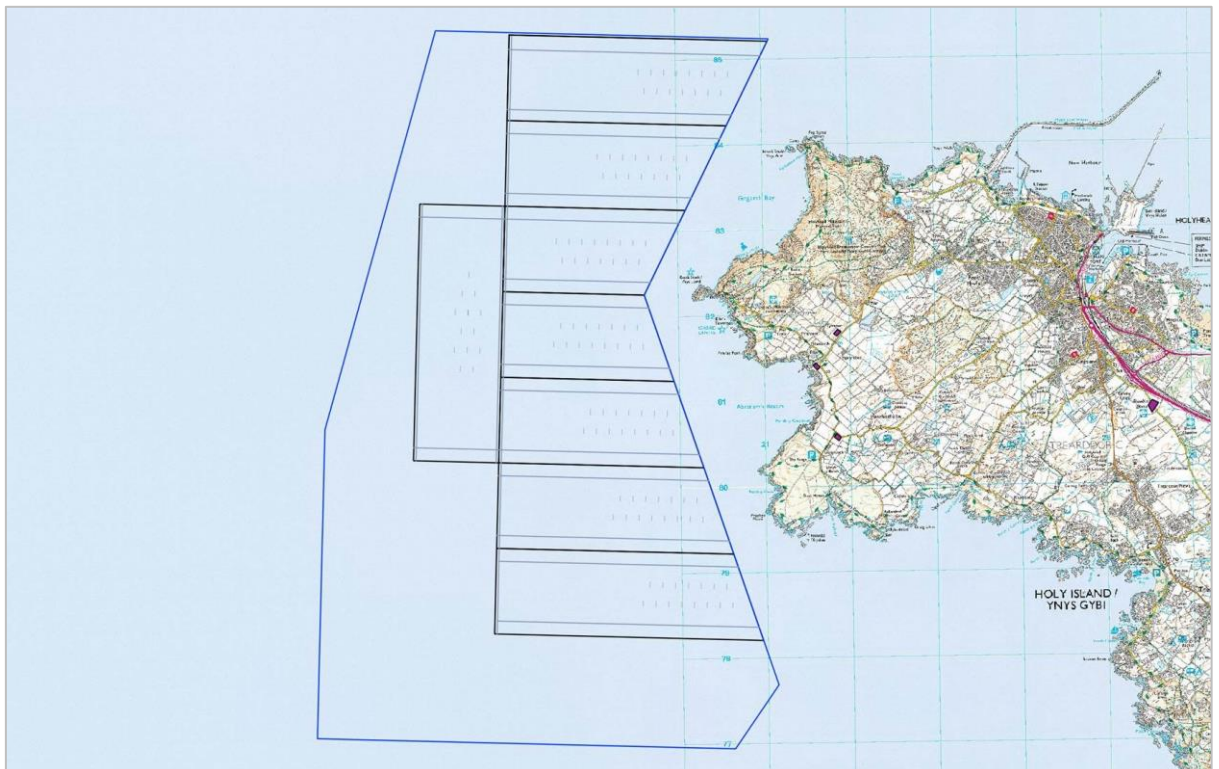


FIGURE 2: EXAMPLE MAXIMUM CAPACITY LAYOUT – SURFACE FLOATING DEVICES (BASED ON DIMENSIONS OF 70M X2M)

3 OVERVIEW OF THE BASELINE MARINE ENVIRONMENT

3.1 METOCEAN CHARACTERISTICS

3.1.1 Visibility

The study area is often cloudy in all seasons with the coast often obscured by low cloud and driving rain. Fog at sea is most common in June and less frequent from November to May. Radiation fog over the land is most common in autumn and winter around dawn.⁴

3.1.2 Wind, Wave and Swell

Generally, the region has a mild maritime climate with periods of strong winds and rough seas. Gales occur most frequently within the winter months. South-westerly gales are considered the most severe.

Waves greater than 5m are rare within the vicinity of the proposed Morlais Zone. The roughest seas are experienced with winds from between the south and north-west. 60% of seas over 2m are recorded within winter. The calmest seas occur within July. The predominant swell is from south and south-west, however, north swells increase within spring and summer.

3.1.3 Site Tidal Conditions

The tidal stream is set N and S in the direction of the coast to the west of Anglesey and changes NNE SSW off the NW tip of Anglesey. The tide is strong around the Promontories but is weaker within the bays. The NW coastal stream is joined by the N stream from Caernarfon Bay tending to set towards the land. The stream turns NNE around South Stack, whereas the SSW stream from North-Stack turns south across Caernarfon Bay and SE around South Stack.

A west-going eddy forms off the coast east of Penryhn Mawr during the SE going stream and there are eddies in Abraham's Bosom and in Gogarth Bay during both streams and in both directions.

It is noted within the Admiralty Sailing Directions (ASD) that there is a rocky islet with dangerous tidal races to the west of South Stack (53°18'.41N 4°41'.98W) which lies

⁴ United Kingdom Hydrographic Office (2014) Admiralty Sailing Directions West Coast of England and Wales Pilot; NP37, 19th Edition.

close off the western extremity of Holy Island and is connected to it by means of a bridge.

Tidal streams in the vicinity of South Stack begin as outlined within **Table 3-1**.

TABLE 3-1: TIDAL STREAM IN THE VICINITY OF SOUTH STACK

Interval from HW Holyhead	Direction
-0605	NNE
+0020	SSW

Table 3-2 gives the tidal diamond for the area around the proposed Morlais Zone. Tidal flows are high, reaching maximum spring flow rates in both directions of up to 5 knots.

**TABLE 3-2: TIDAL DIAMOND FOR PROJECT SITE (ADMIRALTY TOTAL TIDE:
53°19.51'N 4°41.87'W)**

HW Hour	Direction (°)	Spring Rate (kts)	Neap Rate (kts)
-6	047	0.8	0.4
-5	044	3.2	1.6
-4	046	4.1	2.0
-3	038	4.1	2.0
-2	024	1.9	1.0
-1	266	1.2	0.6
HW	249	3.3	1.7
+1	228	4.5	2.2
+2	225	4.4	2.2
+3	223	4.3	2.1
+4	217	2.6	1.3
+5	211	1.4	0.7
+6	180	0.2	0.1

3.2 SEARCH AND RESCUE RESOURCES

Her Majesty's Coastguard (HMCG) is the authority responsible for initiating and coordinating all civil maritime SAR operations in the UK Search and Rescue Region (SRR). This includes the mobilisation, organisation and tasking of adequate

resources to respond to people either in distress at sea, or at risk of injury or death in the cliffs or shoreline of the UK.

The MCA is responsible for requesting and tasking SAR resources made available by other authorities and co-ordinating the subsequent SAR operations. The MCA currently co-ordinates SAR operations through a network of 12 Coastguard Operations Centres (CGOCs).

The CGOCs maintain continuous watch on VHF Channel 16 and 70 for; distress, urgency and safety calls, covering UK waters.

SAR response can be drawn from three levels of responder:

- Dedicated (e.g. RNLI, SAR helicopter);
- Declared (e.g. coastguard vessels, port launches, police boats); and
- Merchant shipping (e.g. vessels transiting in the area).

HMCG provides declared SAR facilities to cover both civil and military operations, exercises and training within the UK SAR.

3.2.1 HM Coastguard SAR Helicopter Base

The closest HM Coastguard SAR station to the Morlais Zone is situated at Caernarfon Airport. The base has been operated by Bristow Helicopters Ltd on behalf of HMCG since it opened in 2015.

3.2.2 The Royal National Lifeboat Institution (RNLI)

The RNLI provides all-weather and inshore lifeboats around the coast for saving life at sea. The RNLI stations near to the Morlais Zone are given within **Table 3-3**. At each of these stations crew and lifeboats are available on a 24-hour basis throughout the year.

TABLE 3-3: RNLI STATIONS NEAR TO THE MORLAIS ZONE

Station	Location	Lifeboats
Holyhead New Harbour	53°19'.17N 4°38'.56W	Christopher Pearce – Severn Class Mary and Archie Hooper- D Class
Trearddur Bay	53°16'.57"N 4°37'.49"W	Hereford Endeavour- B Class Clive and Imelda Rawlins – D Class

3.3 SHELTER

Shelter is listed within the ASD as available at all times in Holyhead Outer Harbour.

3.4 TRAFFIC SEPARATION SCHEMES (TSS)

The closest Traffic Separation Scheme (TSS) is the Off Skerries TSS (53°22'.88N 4°52'27W to 53°32'18N 4°31' 78W). Off Skerries was established for vessels rounding the NW coast of Anglesey. Rule 10 of The International Regulations for Preventing Collisions at Sea (COLREGS) applies. Laden tankers are to avoid the area between the SE boundary of the scheme and the coast.

An un-adopted TSS Is located at the entrance to Holyhead Harbour.

3.5 PILOTAGE

In bad weather or at the request of the vessel, Liverpool Pilots will board off Point Lynas at 53°25'000N 4°17'39W.

3.6 PRINCIPAL MARKS

South Stack Lighthouse is located at 53°18'41N 4°41' 98W. The light is shown throughout 24 hours.

During consultation it was noted by Trinity House that once per year it has a vessel with a heli-pad located up to 1.5 nm off of South Stack in order to carry out routine maintenance. Additionally, approximately every 7 years the vessel would be present for an extended time to support major maintenance activities such as; painting, battery change or modernisation (Annex D - Minutes From Consultation).

3.7 ANCHORAGES

Anchorage in vicinity of the proposed Morlais Zone are given within **Table 3-4**.

TABLE 3-4: NEARBY ANCHORAGES

Anchorage	Description
Abraham's Bosom	53°17'.81N 4°40'.97W - Anchorage in offshore winds. A below water rock lies below the water surface (Pen – las rock) close to the northern entrance to

Anchorage	Description
	the bay with foul ground extending 1 cable southwest from the rock.
Trearddur Bay	53°16'.63N 4°37'.28W Temporary anchorage in offshore winds.

3.8 OFFSHORE RENEWABLE INFRASTRUCTURE (OREI)

OREI within the vicinity of the Morlais Zone is given within **Table 3-5**. The nearest OREI to the Morlais Zone is the Minesto operated Holyhead Deep tidal demonstration site located 1km to the west of the proposed Morlais Zone.

TABLE 3-5: NEARBY OFFSHORE RENEWABLE ENERGY INFRASTRUCTURE

Development Type	Project	Distance from Morlais (km)	Status
Tidal	Holyhead Deep	1	In Development
Tidal	Skerries Tidal Energy	11.4	Lease Expired
Wind Farm	Rhyl Flats	66	Operational
Wind Farm	Gwynt y Mor	67.5	Operational
Wind Farm Extension	Gwynt y Mor	67.5	Proposed
Wind Farm	North Hoyle	81.5	Operational

3.9 OIL AND GAS

The nearest oil and gas infrastructure is the P2292 well which is located 61 km from the Morlais Zone and is, therefore, not considered significant within the assessment.

3.10 MARINE AGGREGATES

The closest marine aggregate extraction site is situated 70 km from the Morlais Zone and as such marine aggregate dredging activities are not considered to present a hazard with respect to the Morlais NRA.

TABLE 3-6: NEARBY MARINE AGGREGATE EXTRACTION

Development Type	Project	Distance from Morlais (km)	Status
Aggregate Extraction	Area 457	70	Operational
Aggregate Extraction	Area 392 / 393	73	Operational

3.11 DREDGE DISPOSAL SITES

There is a spoil ground, Holyhead North located to the west of the Morlais Zone near to Holyhead Deep. The southernmost portion of which overlaps with the western portion of the zone including the western sub-zone. Dredge material from the proposed Holyhead Port expansion is likely to be disposed of at Holyhead North disposal site to the west of the Morlais Zone⁵. The spoil ground is marked by a lit buoy.

3.12 DIVING BOATS

It was identified within consultation that wreck diving occurs within the Morlais Zone area and within close proximity to the site with 200 wrecks registered within the Anglesey area. AIS has confirmed that dive boats occasionally operate close to the Morlais Zone. A collision involving a dive boat was identified from MAIB incident data within 1nm of the Morlais Zone (see **Section 7**).

3.13 EXERCISE AREAS

There are no military exercise areas or firing zones in the vicinity of the site. The closest military practice area is located 12km to the south of the Morlais Zone.

3.14 SUB-SEA CABLES

There are two sub-sea cables in close proximity to the south-east corner of the Morlais Zone. The cables which include; the Emerald Bridge cable and Celtic

⁵ MMO (2017) Scoping Opinion; Port of Holyhead – Holyhead Port Expansion: DC10119

Connect cable, make landfall on the west coast of Holy Island near Porth Dafarch, north of Trearddur Bay.

3.15 PIPELINES

There are no known pipelines in the vicinity of the site.

3.16 EXPLOSIVE DUMPING GROUNDS

There are no explosive dumping grounds in the vicinity of the site.

4 COMMUNICATION, RADAR AND POSITIONING SYSTEMS

The tidal devices are not considered to present any hazard to communication, radar and positioning systems during installation, operations and decommissioning phases.

There would be no adverse or unusual effects on communications, radar and positioning systems caused by the vessels or equipment used during the construction phase except for the possibility of the use of inappropriate International Maritime Mobile (IMM) VHF channels. The use of IMM VHF during construction for communication between ship and shore or between vessels could interfere with other marine activities. The developer should liaise with local Harbour Authority (HA) areas to ensure that suitable working channels are selected to avoid compromising authorised local communications.

There are no known adverse effects on navigation systems from acoustic interference arising from the infrastructure or associated equipment likely to be employed at the site.

5 DATA SOURCES

Data analysis of the baseline data seeks to quantitatively determine the extent of navigation in the vicinity of the Morlais Zone and requires that data and statistics are available to ensure that the risk assessment is as robust and accurate as possible. An assessment of navigation is made based on available data, including:

- Automatic Identification System (AIS) data to determine:
 - Vessel types in the vicinity of the Morlais Zone and their tracks;
 - Gate analysis to discover the frequency and distribution of vessels transiting the area; and
 - Vessel traffic density.

5.1 GUIDANCE

Guidance on the assessment requirement was primarily sought from the MCA Marine Guidance Note (MGN) 543 (M+F) which replaces MGN 371. MGN 543 advises the correct methodology to evaluate navigational safety around OREIs, and this report adheres to this standard accordingly. The full list of guidance utilised within the NRA is outlined within **Table 5-1**.

TABLE 5-1: GUIDANCE DOCUMENTS

Policy / legislation	Key provisions
MGN 543 Guidance on UK Navigational Practice, Safety and Emergency Response Issues	This MGN highlights issues to be considered when assessing the impact on navigational safety and emergency response, caused by OREI developments. Including traffic surveys, consultation, structure layout, collision avoidance, impacts on communications/ radar/ positioning systems and hydrography.
MGN 372 Guidance to Mariners Operating in the Vicinity of UK OREIs	Issues to be considered when planning and undertaking voyages near OREIs off the UK coast.
MGN 166 Guidelines for Voyage Planning	Guidance to address the importance of careful planning and continuous monitoring of a ship's progress.

Policy / legislation	Key provisions
International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the Marking of Man-Made Offshore Structures	Guidance to national authorities on the marking of offshore structures.
International Maritime Organisation (IMO) Formal Safety Assessment. Revised Guidelines for Formal Safety Assessment (FSA) MSC-MEPC.2/Circ.12/Rev.2	Process for undertaking marine navigation risk assessments.
Royal Yachting Association (RYA) Position on Offshore Energy Developments	Outlines recreational boating concerns for offshore renewable energy developments.
Regulatory expectations on moorings for floating wind and marine devices – HSE and MCA 2017	Guidance document on mooring arrangements for OREIs.
Cumulative Impact Assessment Guidelines issued by RenewableUK in June 2013	Guidance on the assessment of cumulative impacts in the vicinity of OREIs.
Planning Inspectorate (PINS) 'Advice Note 9: Rochdale Approach'	Guidance on the utilisation of a Rochdale Approach.
International Regulations for Preventing Collisions at Sea 1972 (as amended) (ColRegs)	Guidance to prevent collisions at sea.

5.2 DATA COLLECTION

Marico has undertaken the Navigation Risk Assessment utilising the following data sources:

- Automatic Identification System (AIS) data;
- RADAR data;
- GIS shapefiles;
- Maritime Incident Data (Maritime Accident Investigation Branch (MAIB) 1997-2017;
- Admiralty Sailing Directions –West Coast of England and Wales Pilot, NP37, 19th Edition, 2014; and
- UK Admiralty Charts: 1970, 1413 (All cartography in this report, unless otherwise stated, is to WGS84 UTM Zone 30N standard. All marine charts are in a Mercator projection. Charts are not suitable for navigational purposes).

5.3 STAKEHOLDER CONSULTATION

Stakeholder consultation was undertaken with local and national consultees, as part of the Preliminary Hazard Analysis (PHA) initially (Phase 1 - National) and to inform the NRA (Phase 2 – Local and National) in accordance with MGN 543. Stakeholder meetings undertaken are outlined within **Table 5-2**, the minutes from which are located within Annex D - Minutes From Consultation.

TABLE 5-2: CONSULTATION MEETINGS

Date	Consultation Phase	Consultee
October 2018 (Meeting)	Phase 1 – PHA (National)	MCA
October 2018 (Teleconference)	Phase 1 – PHA (National)	Chamber of Shipping
October 2018 (Teleconference)	Phase 1 – PHA (National)	Trinity House

Date	Consultation Phase	Consultee
November 2018 (Meeting)	Phase 2 – NRA (Local)	Welsh Fishermen's Association
November 2018 (Meeting)	Phase 2 – NRA (Local)	Harbour Master
November 2018 (Meeting)	Phase 2 – NRA (Local)	Stena Line
November 2018 (Meeting)	Phase 2 – NRA (Local)	Local Recreation and RYA
November 2018 (Meeting)	Phase 2 – NRA (Local)	RNLI
November 2018 (Meeting)	Phase 2 – NRA (Local)	Irish Ferries
December 2018 (Meeting)	Phase 2 – NRA National	RYA
December 2018 (Meeting)	Phase 2 – NRA National	Chamber of Shipping
January 2019 (Meeting)	Phase 2 – NRA National	MCA Trinity House

6 VESSEL TRAFFIC ANALYSIS

Vessel traffic analysis has been undertaken to inform the baseline assessment of traffic within the proposed Morlais Zone and surrounding area.

6.1 DATA COLLECTION

AIS data was collected to better understand the traffic profile of vessels transiting the project area and any potential impacts the development may have upon navigation.

The following were assessed through the analysis of AIS:

- Location of the Morlais Zone relative to areas used by any type of marine craft;
- Numbers, types and sizes of vessels presently using the Morlais Zone including; course, name, IMO Number and nationality where possible;
- Non-transit uses of the areas, e.g. fishing, recreation, racing or military purposes;
- Presence of transit routes used by coastal or deep-draught vessel on passage; and
- Alignment and proximity of the development site relative to adjacent shipping lanes.

Further information was gathered through consultation with key stakeholders including representatives of recreational and fishing organisations, and the local harbour master.

6.1.1 Automatic Identification Systems

In 2000, IMO adopted a new requirement (as part of a revised Chapter V of SOLAS) for ships to be fitted with AIS.

AIS was developed primarily as a collision avoidance tool. Vessels that carry AIS broadcast key information such as identity, name, type, speed, course, etc., at regular intervals to all AIS receivers within VHF range. AIS exists in two forms, Class A and Class B: the former is mandated by IMO for all large vessels and passenger vessels; the latter is utilised on a voluntary basis by non-SOLAS vessels such as recreational craft.

Regulation 19 of Safety of Life at Sea (SOLAS) Chapter V - sets out the navigational equipment to be carried on board ships according to ship type. AIS is required to be carried on:

- All ships of 300 and greater gross tonnage and engaged on international voyages;
- Cargo ships of 500 and greater gross tonnage not engaged on international voyages; and
- All passenger vessels irrespective of size.

AIS uses one of two VHF frequencies, namely:

- AIS 1: 161.975 MHz; and
- AIS 2: 162.025 MHz.

Vessels transmit packets of dynamic and static information in 26 millisecond time-slots of which there are 2,250 each minute. Static data, i.e. that defining the unchanging description of a vessel, e.g. its identity, type, etc. is broadcast every 6 minutes. Dynamic information giving details of the vessels passage and actions, e.g. course, speed, heading, etc. is broadcast at intervals dependent on the speed and type of vessel. The normal reporting interval for Class A AIS is:

- 3 minutes for a vessel at anchor (speed of less than 3 knots);
- 10 seconds for a vessel in transit (speed less than 14 knots);
- 4 seconds for a vessel in transit and altering course;
- 6 seconds for a vessel in transit (speed between 14 and 23 knots); and
- 2 seconds for a vessel in transit (speed greater than 23 knots) or altering course (speed greater than 14 knots).

For AIS Class B installations, the reporting intervals are:

- 3 minutes for a vessel at anchor (speed of less than 2 knots); and
- 30 seconds for a vessel underway (speed greater than 2 knots).

6.1.2 AIS Limitations

It should be noted that there are limitations with AIS data. As noted above, class B installations are not mandatory, therefore many small leisure and fishing vessels are not equipped with AIS transmitters at all, or if they are, the transmitters may not be switched on if power saving is a concern.

Furthermore, while class A AIS is mandatory on most larger vessels, it is possible to switch transmitters off and it is not infrequent for mariners to do so (for example military or government vessels not wishing to reveal their locations).

6.1.3 RADAR Survey

To overcome the limitations posed by utilisation of AIS alone and in line with MGN 543 requirements, winter and summer RADAR surveys were undertaken for representative summer and winter periods.

The MCA has recently reiterated the requirement for radar data collection for all OREIs.⁶ The validity of the data is generally referenced to the most recent survey period. MGN 543 advises: *“An up to date traffic survey of the area should be undertaken within 24 months prior to submission of the Environmental Statement. This should include all the vessel types found in the area and total at least 28 days duration but also take into account of seasonal variations in traffic patterns and fishing operations”*.

“However, if deemed necessary, to cover seasonal variations, peak times or perceived future traffic trends, the survey period may be extended to a maximum of 24 months. For all OREI developments, subject to the planning process, the survey may be undertaken within 24 months prior to submission. If the Environmental Statement is not submitted within 24 months an additional 14 days continuation survey data may be required for each subsequent 12-month period. Should there be a break in the continuation surveys, a new full traffic survey may be required, and the time period starts from the completion of the initial 28 day survey period” (MGN 543).

6.1.4 Recording Periods

The data collected for utilisation within the Navigation Risk Assessment is summarised within **Table 6-1**.

TABLE 6-1: RECORDING PERIODS

Data Type	Season	Duration	Time Period
AIS	Summer	2 weeks	26 th August - 09 th September 2017
RADAR	Summer	2 weeks	26 th August - 09 th September 2017
AIS	Winter	2 weeks	05 th April - 19 th April 2019
RADAR	Winter	2 weeks	05 th April - 19 th April 2019
AIS	Winter	6 Months	01 st October 2017 - 31 st March 2018 ⁷

⁶ MCA Letter to OREI Developers – Hydrographic surveys and navigation risk assessments for Offshore Renewable Energy – MGN 371

⁷ Six months of AIS data from between October 2017 and March 2018 were additionally sourced to account for any seasonal variances in ferry activity and usage of the poor weather routes. The data includes Class A and Class B vessels.

It is noted that an additional winter survey was undertaken in 2017, however, given that the survey would exceed the maximum 24-month validity period, as stipulated within MGN543, an up-to-date survey was acquired. The original winter survey data is presented within the PHA assessment.

6.2 VESSEL TRACK ANALYSIS

All vessel tracks recorded by AIS and RADAR between 05th April and 19th April 2019 and 26th August and 19th September 2017 are shown below in **Figure 3**. Immediately evident is the inshore passage utilised by smaller low-draught vessels such as; recreational craft, workboats and small fishing vessels and the ferry route to the north of the Morlais Zone utilised by Irish Ferries and Stena Line (see **Figure 7**).

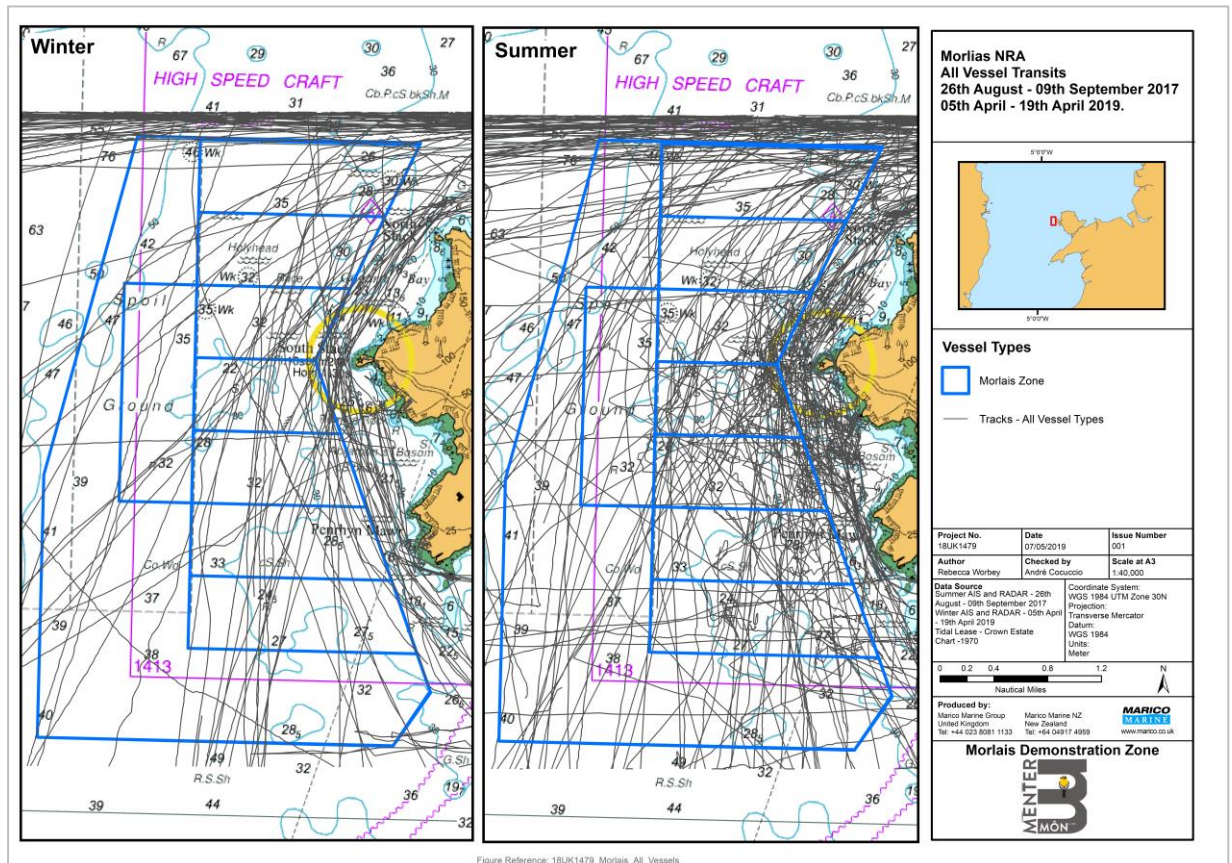


FIGURE 3: VESSEL TRACKS - SUMMER 2017 AND WINTER 2019.

6.3 ANALYSIS BY VESSEL TYPE

Analysis according to vessel type has been undertaken to establish existing traffic patterns within the proposed Morlais Zone, the results of which are presented below.

6.3.1 Vessel Classification

Following assessment of the primary vessel types present within the area, vessel types were grouped in to the categories outlined in **Table 6-2** for analysis and assessment within the NRA.

TABLE 6-2: VESSEL CATEGORIES

Ref	Vessel Type Category	Draught	Including
1	Commercial Ship	>3m	Cargo vessels, tankers, dredgers, survey vessels (draught >3m), buoy laying vessels, commercial fishing vessels/ fish carriers.
2	Passenger Vessel	>3m	Ferries, cruise ships
3	Fishing Vessel	<3m	Fishing Vessels
4	Recreational Vessel	<3m	Yachts, power boats, kayaks, canoes
5	Other Vessel	<3m	Tugs and tows, survey vessels, RNLI, construction and maintenance vessels, cable laying vessels.

6.3.2 Commercial Ships

The tracks of commercial vessels >3m draught (including cargo, tankers and dredgers) recorded during two-weeks of winter 2019 and two weeks of summer 2017 are shown in **Figure 4**.

There was one vessel of this category within the winter dataset; the general cargo vessel *Halenic* (unladen draught 3.2m, laden draught 5.5m). This vessel transited 0.2nm from the western boundary of the Morlais Zone.. There were two vessels of this category within the summer dataset; the buoy laying vessel *Patricia* (draught 4.5m) and the dredger *DEO Gloria* (draught 3.3m). No tankers were recorded within either dataset.

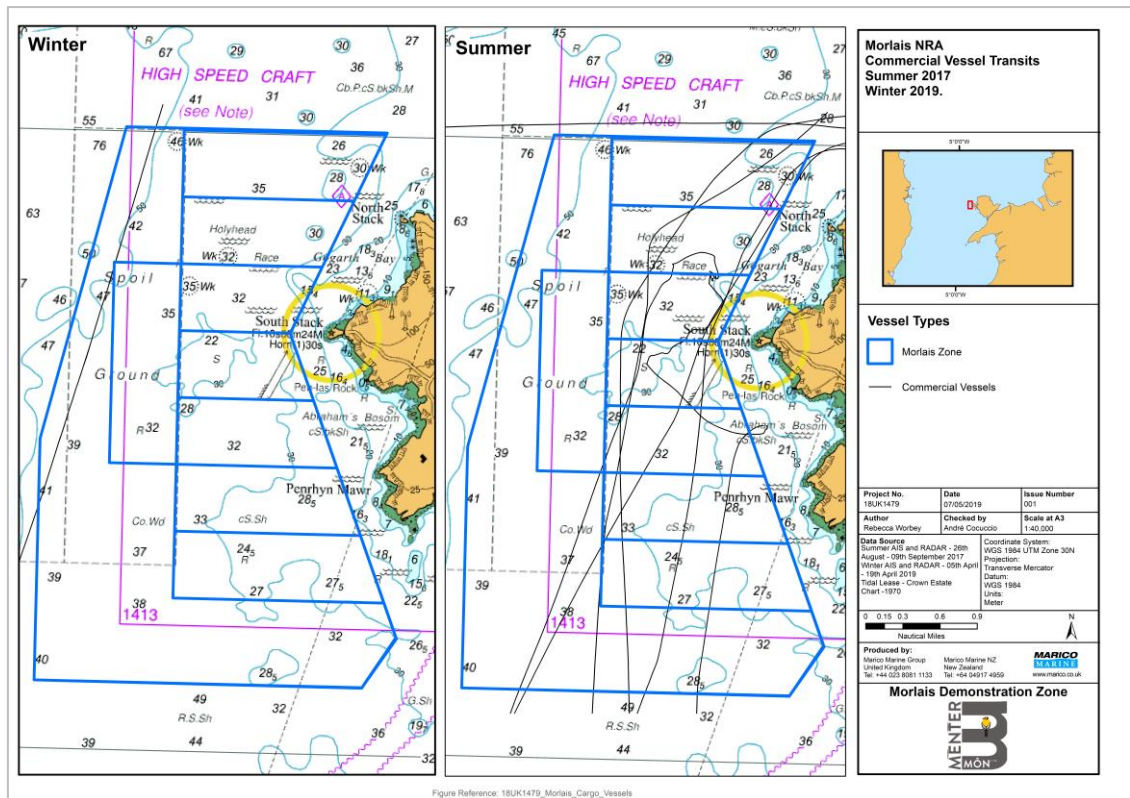


FIGURE 4: COMMERCIAL VESSEL TRACKS - SUMMER 2017 AND WINTER 2019

6.3.3 Passenger Vessels

Irish Ferries and Stena Line ferries operate to the north of the proposed Morlais Zone as shown in **Figure 6** and **Figure 7**. Typically, the ferries transit clear of the northern zone boundary, however, occasionally pass within the northern two sub-zones and the western sub-zone during poor weather conditions. A summary of poor weather routing from consultation is given within **Table 6-3** and **Figure 5**.

TABLE 6-3: CONSULTATION FEEDBACK IN RELATION TO POOR WEATHER ROUTEING

Consultee	Feedback
Stena Line	<ul style="list-style-type: none"> During a SW gale (rare but considered to be the most difficult) 046° line is utilised, which takes the vessel through the Morlais Zone. Alternative weather routing plus 100% cargo lashing must be taken with a forecast of >4m waves. Ferries do not transit near to the tidal race.

Consultee	Feedback
Irish Ferries	<ul style="list-style-type: none"> • The ferries will not normally operate in 5m waves. Irish Ferries has a 2.5m sea state limit. • 7° Poor weather route is utilised in SW gales and when sea state is building up to 3.5m significant waves. • Holyhead Deep is considered to be an Area To Be Avoided (ATBA) during high seas as this is the main area of wave build up. • Irish Ferries avoid navigating too close to shore due to wave build up. Irish Ferries never transit closer than half a mile to shore. • Usage of the alternative poor weather routes varies. For example: they were utilised for approximately 3 weeks in 2017 (mainly within November) and 3 days so far in 2018. • Waiting area to the south of the Morlais Zones rarely utilised (2 times in 13 years by the Ulysses and similar usage by Epsilon). •
Holyhead Harbour Master	<ul style="list-style-type: none"> • Seas in the vicinity of the Holyhead Deep can be particularly rough and the area is avoided by the ferries.

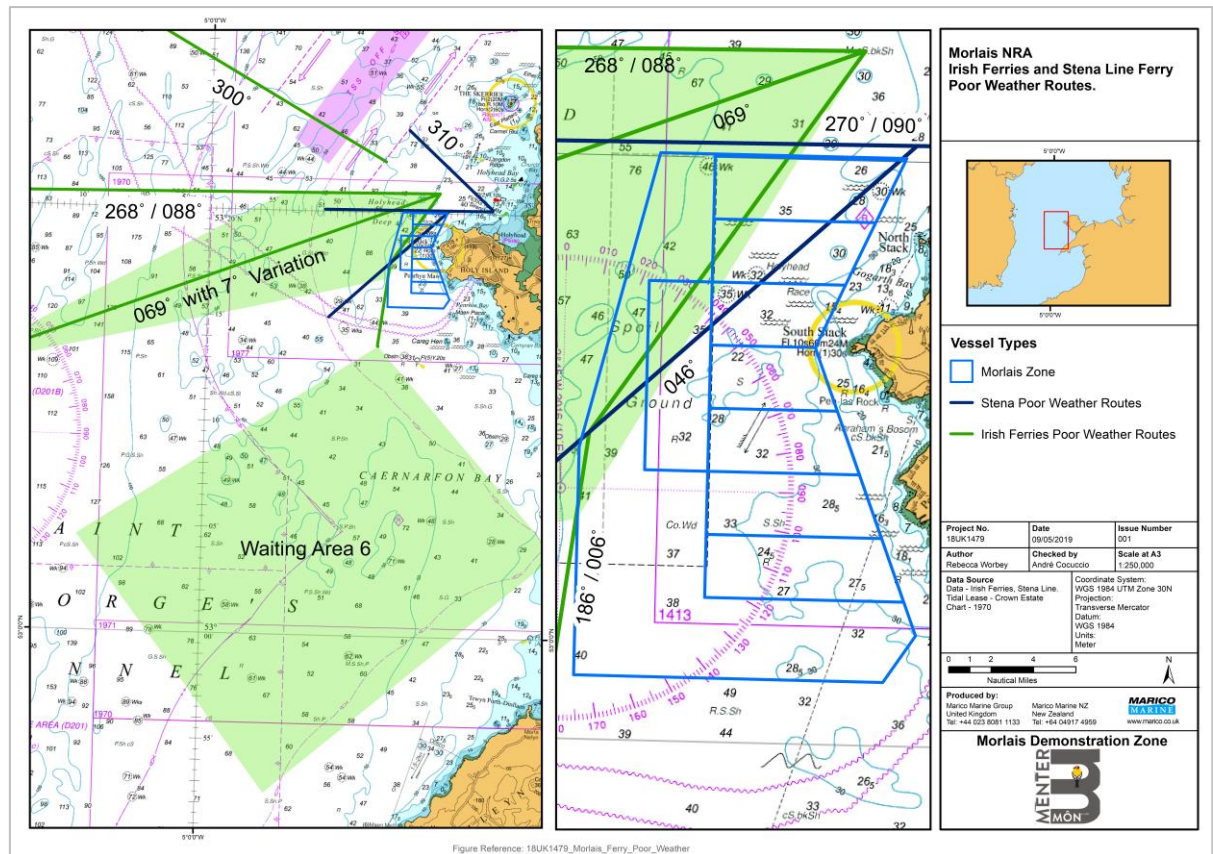


FIGURE 5: IRISH FERRIES AND STENA LINE –INDICATIVE POOR WEATHER ROUTES FROM CONSULTATION

Six months of AIS data from between October 2017 and March 2018 was sourced to account for any seasonal variances in ferry activity and usage of the poor weather routes. The data includes Class A and Class B vessels.

Epsilon is noted in **Figure 7** transiting through the proposed Morlais Zone to anchor at Abrahams Bosom on 03rd March 2018. Although this is considered a rare event (see **Table 6-3**), alternative poor weather/ emergency anchor routes would likely need to be established, should devices with an UKC of <20m be deployed within the proposed Morlais Zones.

In addition to ferries, five transits were made by four unique cruise ship vessels; *Hebridean Sky* (draught 4.2m), *Corinthian* (draught 4m), *Variety Voyager* (draught 3.4m) and *Balmoral* (draught 2.1m) within the two-week summer 2017 dataset. The cruise ships, while infrequent, are noted occupying a larger portion of the proposed Morlais Zone and are present within all nine sub-zones. Cruise ships undertake thorough passage planning and, in contrast to ferries, cruise ships may more easily alter passage plans to accommodate offshore infrastructure.

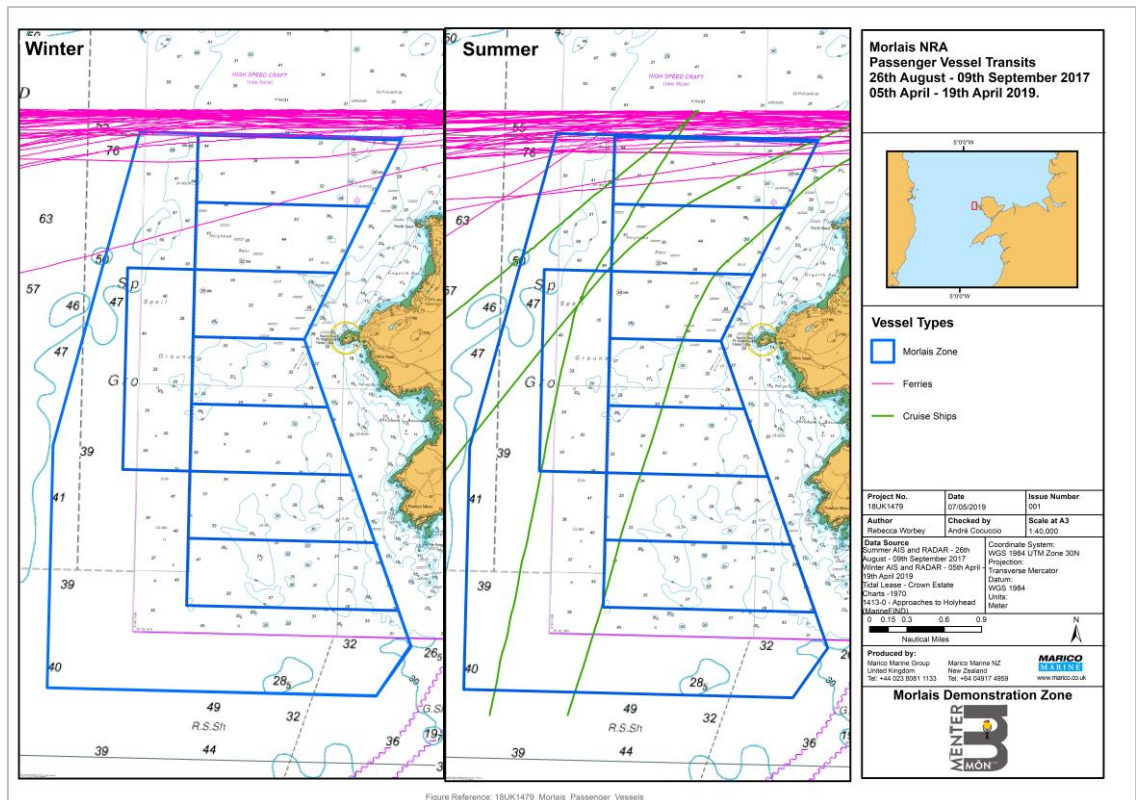


FIGURE 6: PASSENGER VESSEL TRANSITS –SUMMER 2017 AND WINTER 2019

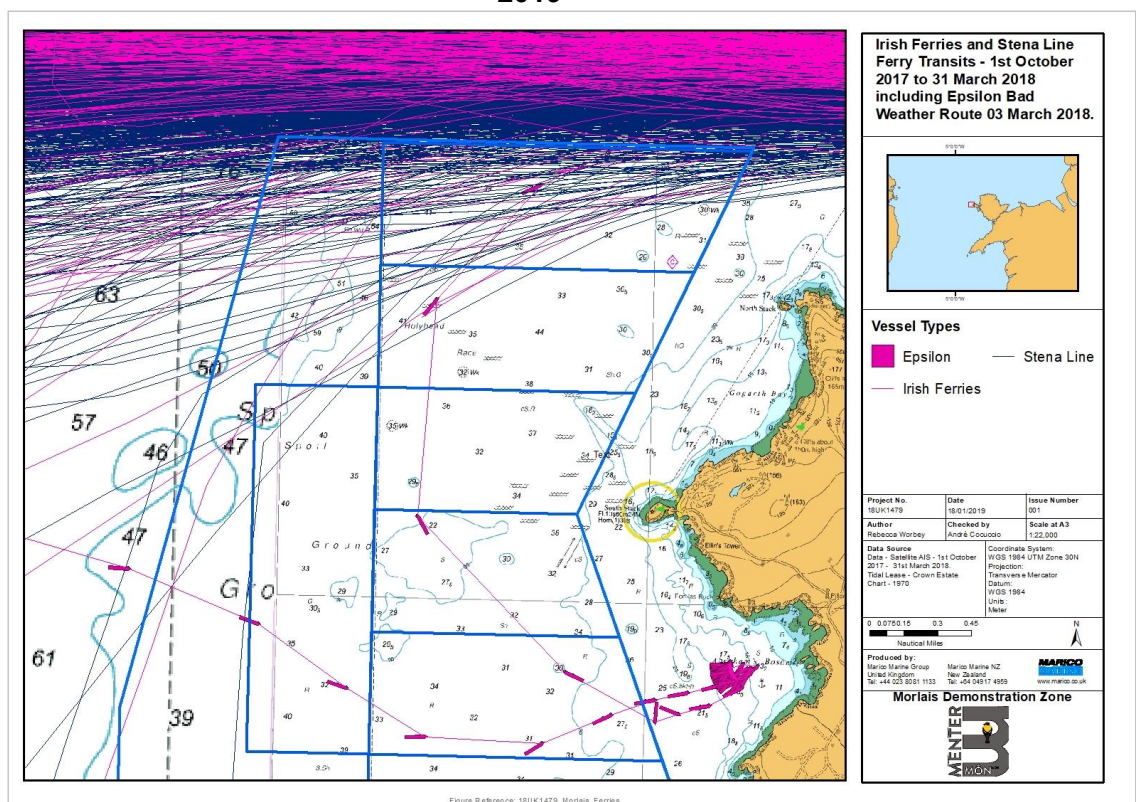


FIGURE 7: FERRY TRANSITS - 01ST OCTOBER 2017 TO 31ST MARCH 2018

6.3.4 Naval Vessels

Naval vessels may not broadcast AIS given the sensitive nature of their operations and, as such, may be under-represented within the datasets. **Figure 8** shows the tracks naval vessels recorded within the summer and winter 2017 surveys.

Two transits by one unique vessel, the military training vessel *Smit Don*, was recorded within the proposed Morlais Zone within the winter dataset. One transit by *Smit Don* was recorded within the northern most sub-zone of the proposed Morlais Zone within summer. *Smit Don* has a recorded draught of <3m.

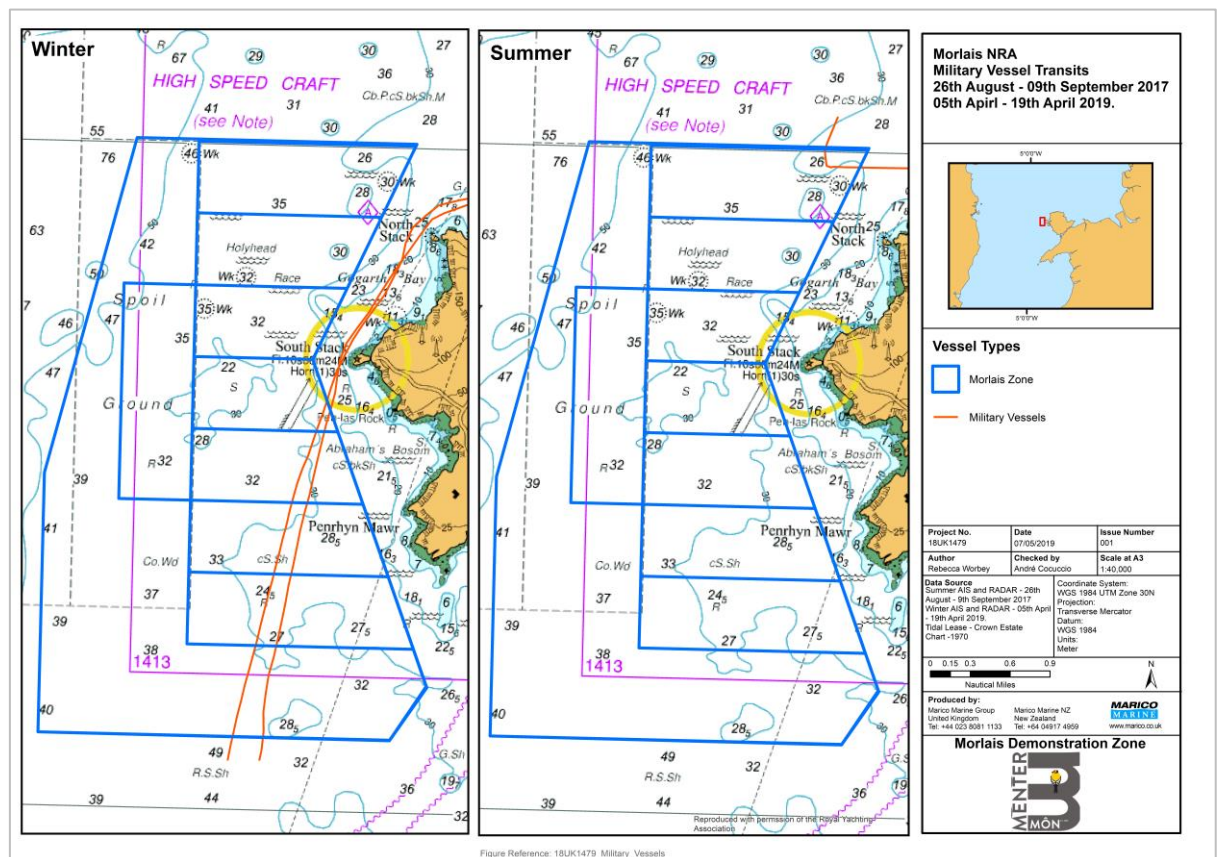


FIGURE 8: NAVAL VESSEL TRACKS - SUMMER 2017 AND WINTER 2019

6.3.5 Other Vessels

Figure 9 shows an assortment of other vessel types which are active near the project, including; tugs and tows, survey vessels, RNLI vessels, construction and maintenance vessels and cable laying vessels. This vessel category is active across the entirety of the proposed Morlais Zone and is primarily comprised of vessels with draught <3m. *MV Seekat C* is noted undertaking Morlais project related surveys within the summer dataset. Unsurprisingly, the number of 'other' category vessels is much higher in summer than in winter.

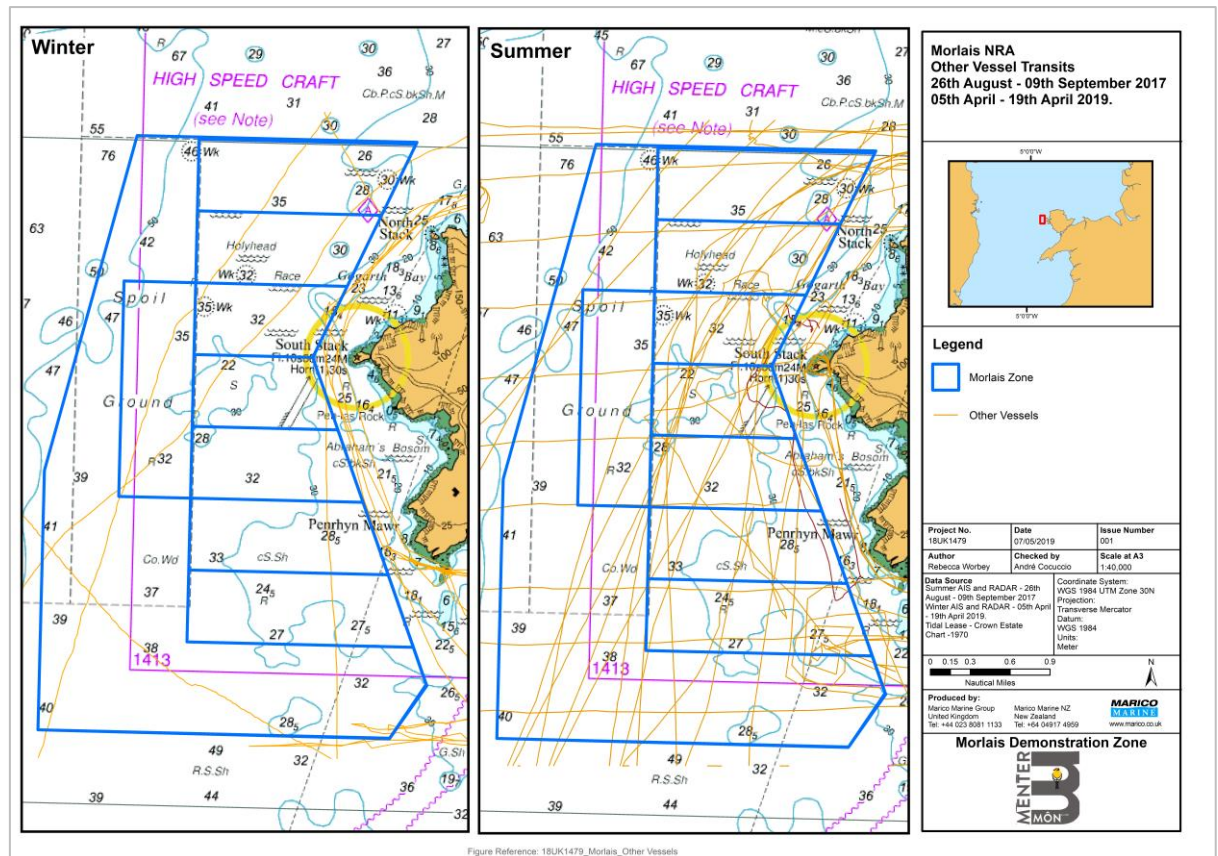


FIGURE 9: OTHER VESSEL TRACKS - SUMMER 2017 AND WINTER 2019

6.3.6 Fishing Vessels

Holyhead is one of three main commercial fishing ports in Wales. Catch types within the vicinity of the Morlais Zone include; velvet crab, lobster, green shore crab, whelks, scallops and skate. Fishing methods include; fixed netting, Danish ring netting, longlining and potting. It was noted during consultation that, although runs within the area are good, very little pelagic fishing occurs as there is no quota to fish it. Subsequently, no demersal or pelagic fish are landed at Holyhead.

The tracks of fishing vessels during summer and winter from radar and AIS are given in **Figure 10**. The ASD⁸ details that within this region, inshore trawlers 'may be encountered at any time in depths of 25m to 35m' and that pots may be found up to 10 miles offshore'. The tracks within the inshore passage and those actively fishing within the eastern portion of the proposed Morlais Zone are comprised of smaller fishing vessels that do not carry AIS while the majority of fishing vessels on transit are larger AIS carrying vessels. It is noted that vessels engaged in fishing are more

⁸ United Kingdom Hydrographic Office - Admiralty Sailing Directions: West Coast of England Pilot (2014), NP37, 19th Edition, Chapter 7 – North-West Coast of Wales Including The Island of Anglesey and the Menai Strait.

prevalent within summer than winter where the majority of vessels are on transit through the proposed Morlais Zone.

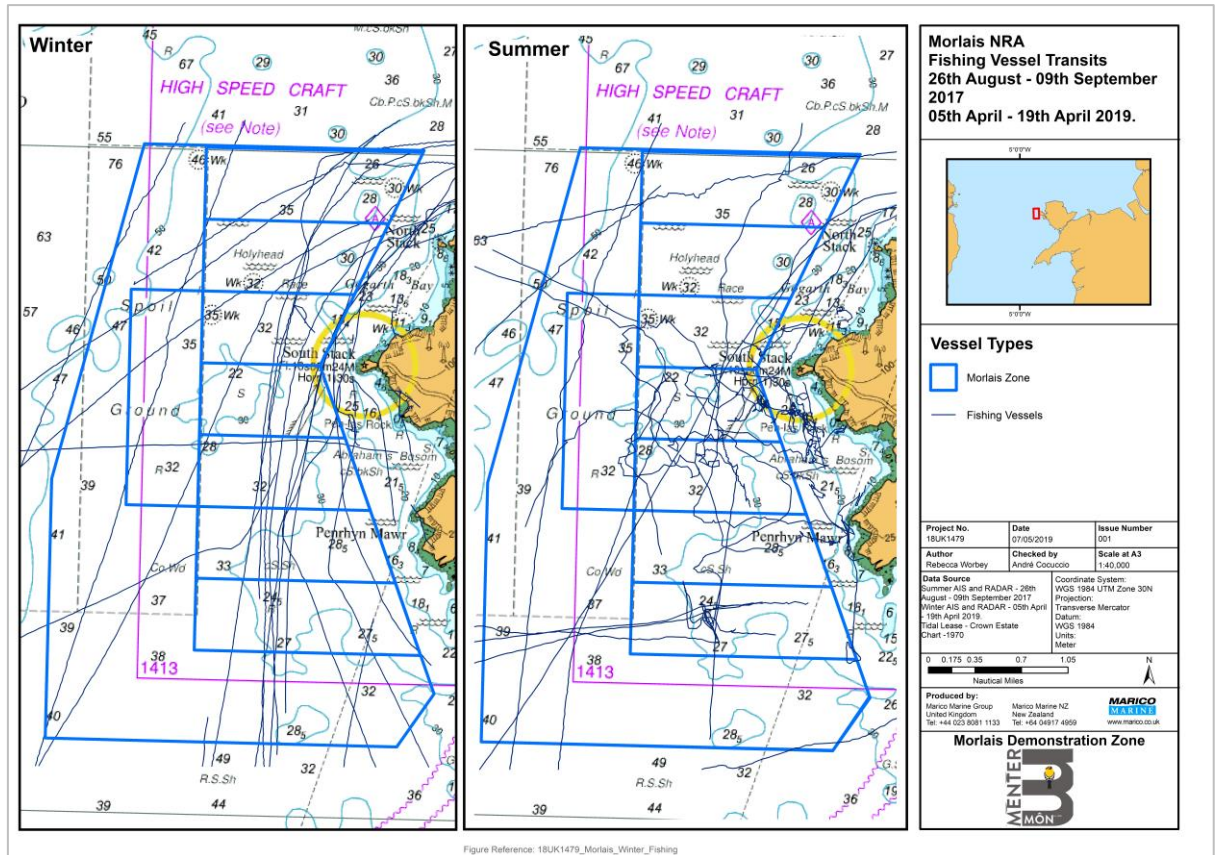


FIGURE 10: FISHING VESSEL TRACKS - SUMMER 2017 AND WINTER 2019

Fishing data from AIS and RADAR has been supplemented by fishing intensity data as recorded by the MMO using the Vessel Monitoring System (VMS). VMS is required on vessels greater than 15m Length Over-All LOA and effort is presented in kW hours (kWh) (calculated by multiplying the time associated with each VMS report in hours by the engine power of the vessel concerned at the time of the activity).

Fishing intensity from VMS in the vicinity of the Morlais Zone is shown within **Figure 11**. Intensity is determined to be low at less than 20,000 kWh per year, particularly to the west of the zone where the intensity falls to <5,000 kWh per year.

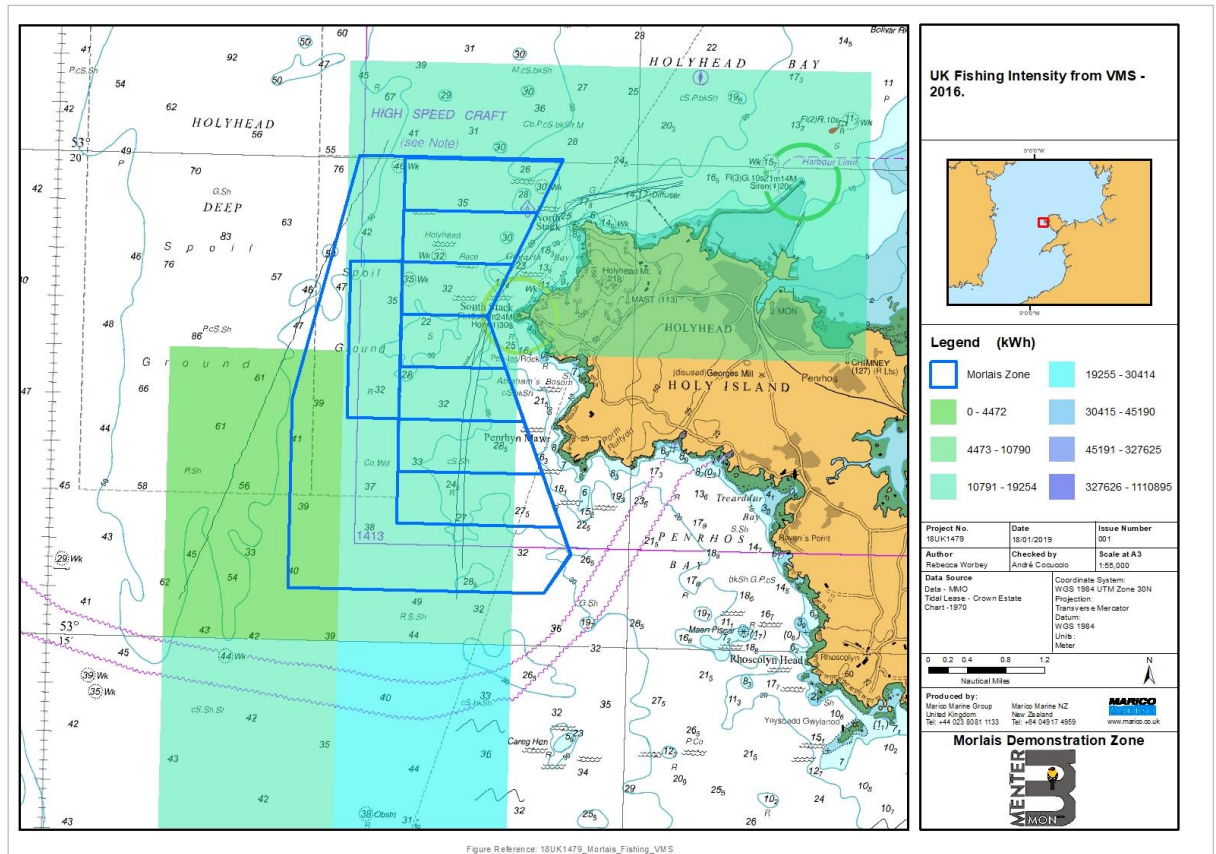
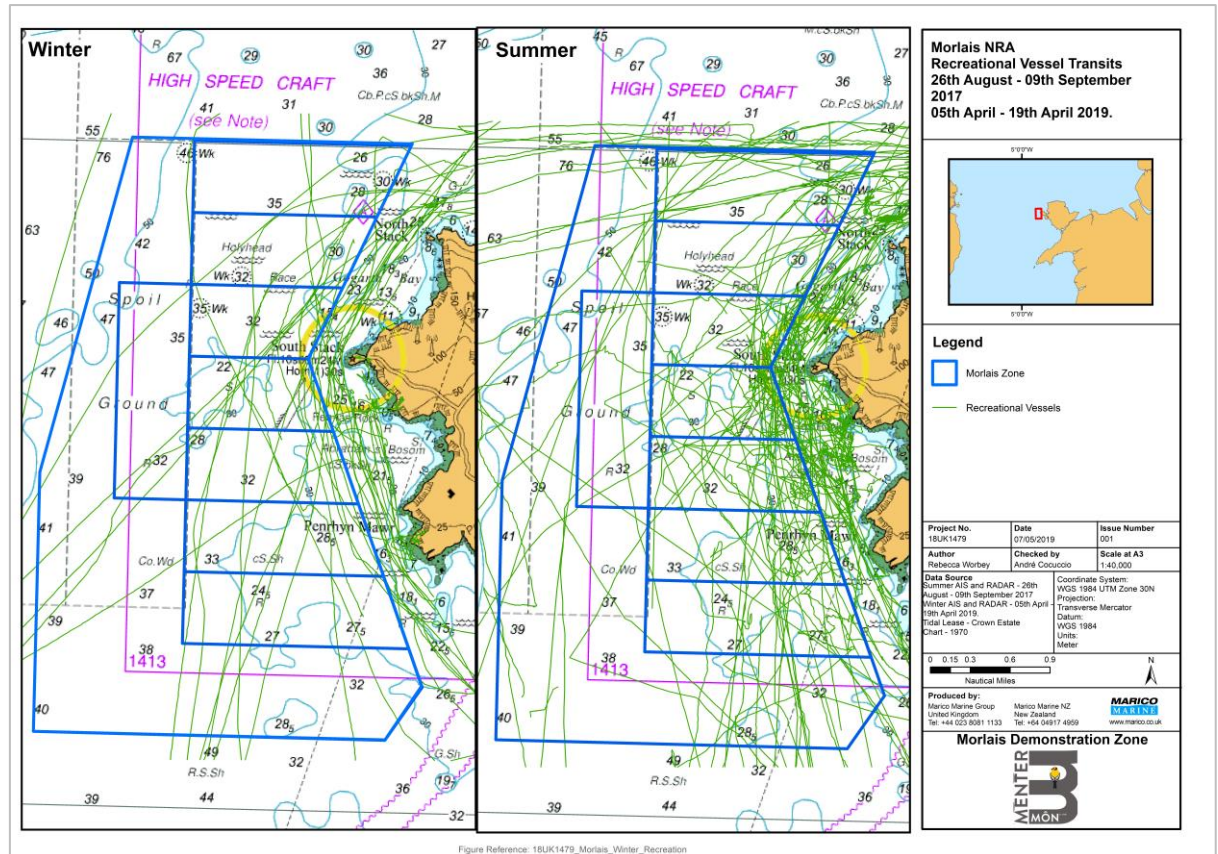


FIGURE 11: FISHING INTENSITY (KWH) FROM VMS DATA - 2016

6.3.7 Recreational Vessels

The tracks of recreational vessels are given within **Figure 12**. Most tracks are concentrated close to shore with small recreational craft, including yachts, primarily utilising the inshore passage to the east of the Morlais Zone. The density of recreational vessels increases substantially in summer where the area occupied by these vessels is much greater, overlapping the eastern portion of the proposed Morlais Zone, particularly in the vicinity of South Stack. In consultation, August was described as the busiest month as a result of favourable weather conditions and the school holidays. Vessel tracks may, therefore, be more numerous within an August survey.



**FIGURE 12: RECREATIONAL VESSEL TRACKS - SUMMER 2017
AND WINTER 2019**

6.4 ANALYSIS BY VESSEL LENGTH

Vessel transits by LOA from AIS between 01st October 2017 and 31st March 2018 are shown in **Figure 13**. The majority of vessels transiting through the Morlais Zone are <21m LOA corresponding to; recreational, fishing and other vessel categories. All vessels transiting through the proposed Morlais Zone with a LOA >167m transited within the northern most two sub-zones and the western-most sub-zone with the exception of *Epsilon* (see **Figure 7**) which transiting through the proposed Morlais Zone to anchor at Abrahams Bosom on 03rd March 2018.

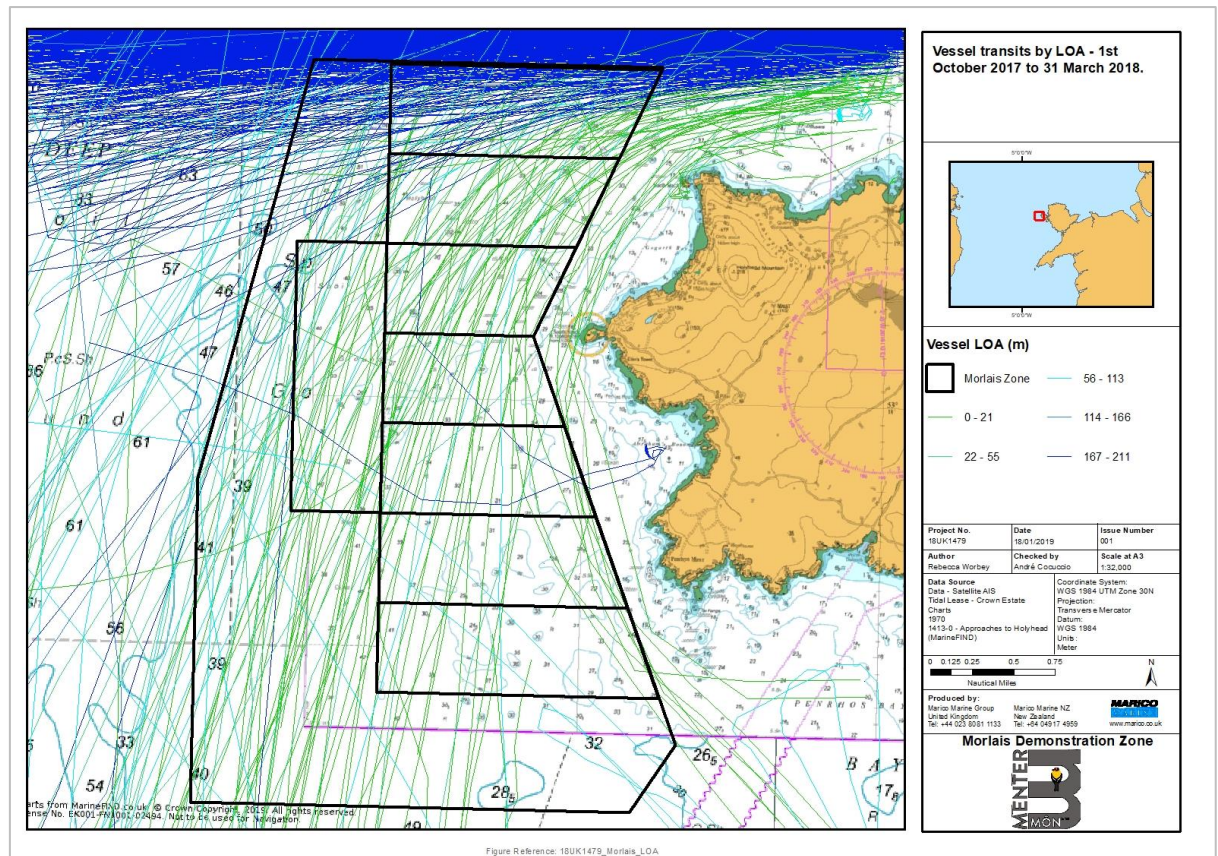


FIGURE 13: VESSEL TRACKS BY LOA (AIS ONLY)

6.5 DENSITY ANALYSIS

Density analysis was undertaken using a fixed Cartesian grid system to count the number of vessel transits through each given 100m² cell.

Vessel transit density from the summer 2017 and winter 2019 RADAR and AIS surveys is represented within **Figure 14**. The inshore passage and ferry route to the north of the zone are clearly evident, demonstrating the highest traffic densities.

Vessel transit density per month across the Morlais Zone for the winter 2017 / 2018 period (from AIS only) is depicted in **Figure 15**. It is evident that traffic density of larger vessels carrying AIS is low within the Morlais Zone during winter with <4 transits per month across all sub-zones, with up to 12 transits per month occurring in the northern most 200m of the Morlais Zone as a result of the ferry route.

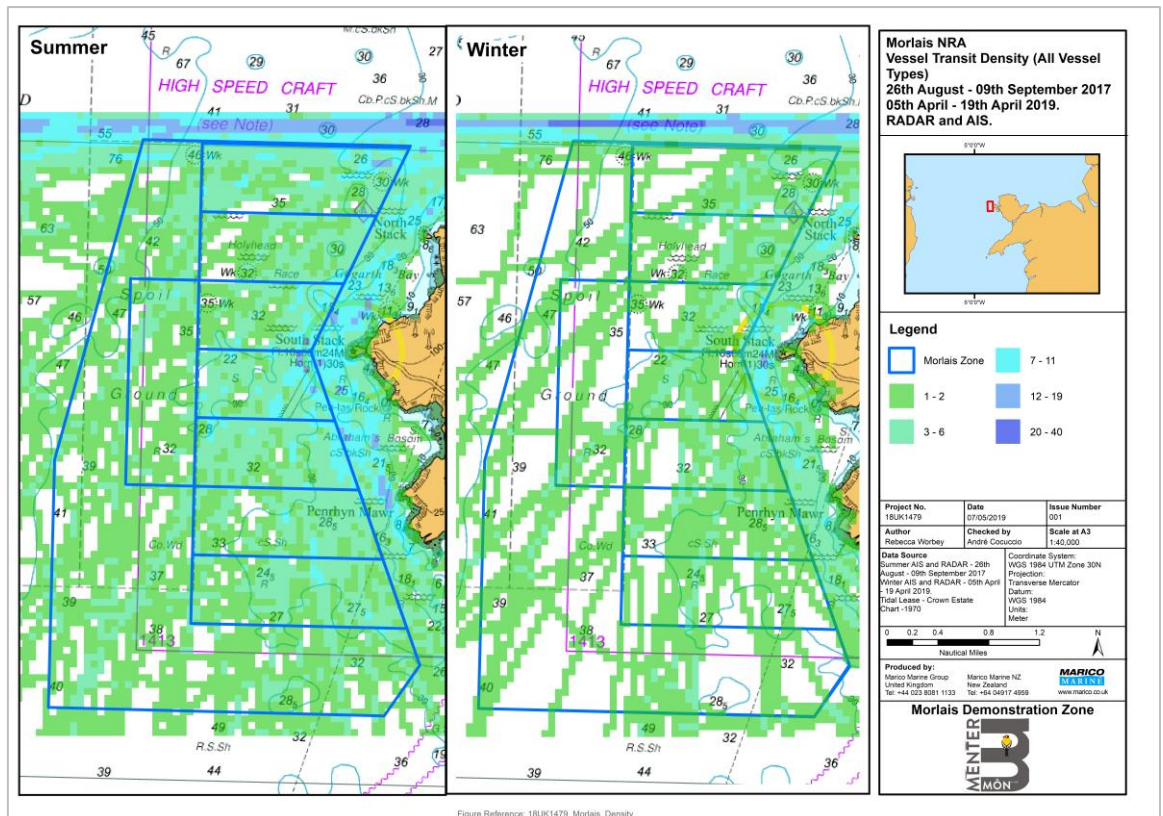


FIGURE 14: DENSITY – ALL VESSELS (SUMMER 2017 – WINTER 2019) AIS & RADAR

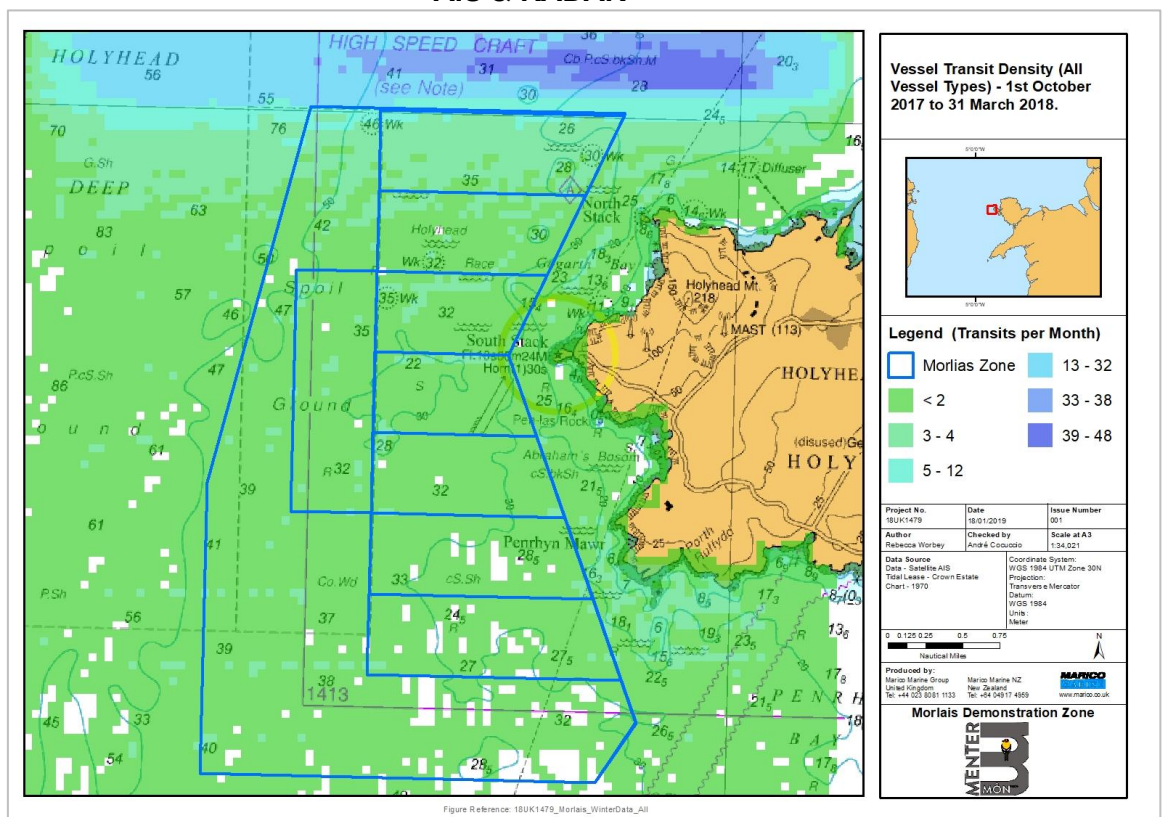


FIGURE 15: DENSITY – ALL VESSELS (01ST OCTOBER 2017 – 31ST MARCH 2018) AIS ONLY.

6.6 GATE ANALYSIS

Gate analysis is a tool used by Marico Marine to examine the frequency and direction of traffic through a linear 'gate'. Transects of known distance are created perpendicular to a channel and columns created depending upon the frequency and direction (course) of vessel tracks passing through the gate.

For the purposes of gate analysis, the two-weeks summer 2017 radar and AIS data was utilised to represent the worst case. Gate analysis was conducted across an east- west trending gate through the centre of the proposed Morlais Zone from South Stack as depicted within **Figure 16**.

In total 108 transits occurred through the gate. These transits have been analysed according to type in Figure 17. The most common vessel type to transit the gate were recreational vessels, accounting for 52% of all transits, with other category vessels, fishing and passenger vessels accounting for 30%, 12% and 6% respectively. No cargo vessels or tankers transited through the gate during the two-week survey period.

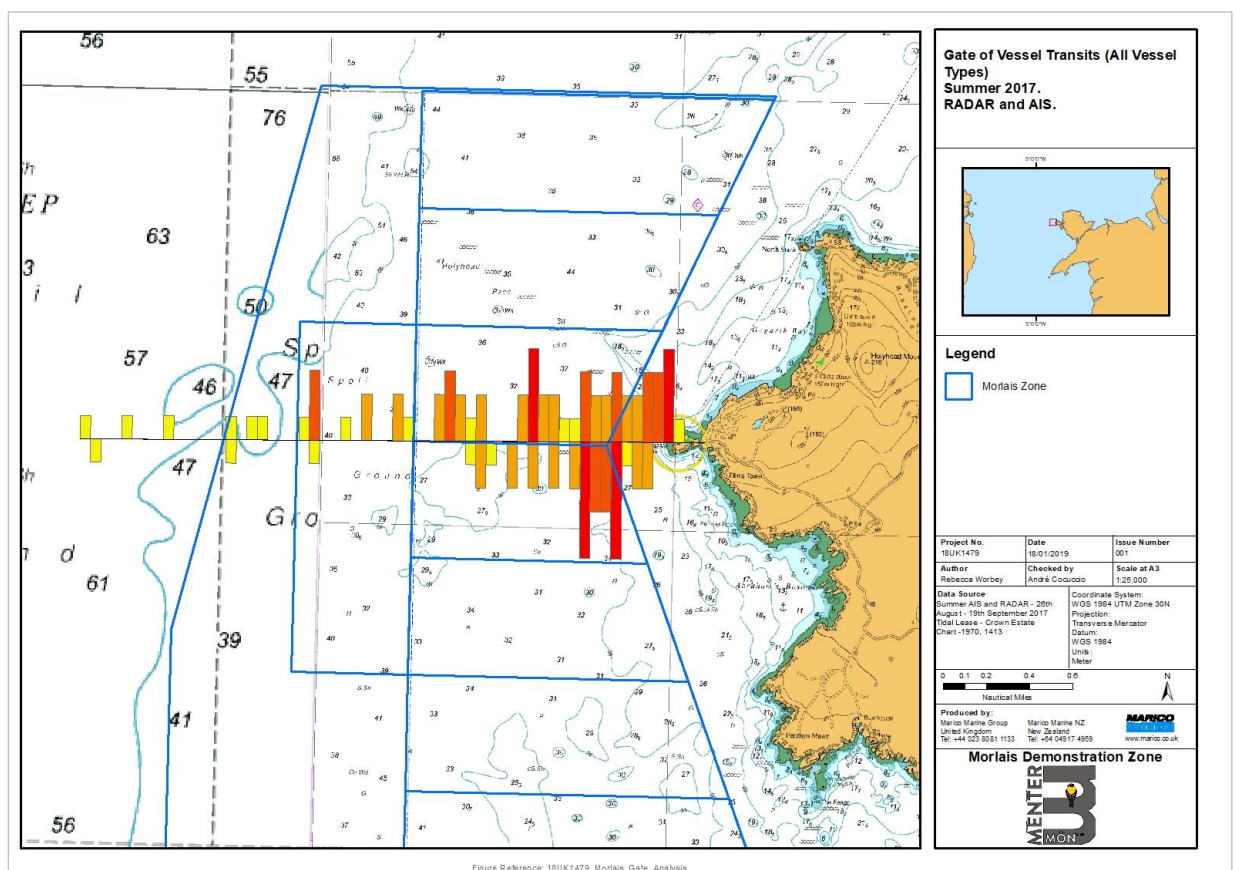


FIGURE 16: TRANSITS THROUGH EW GATE (JULY 2017)

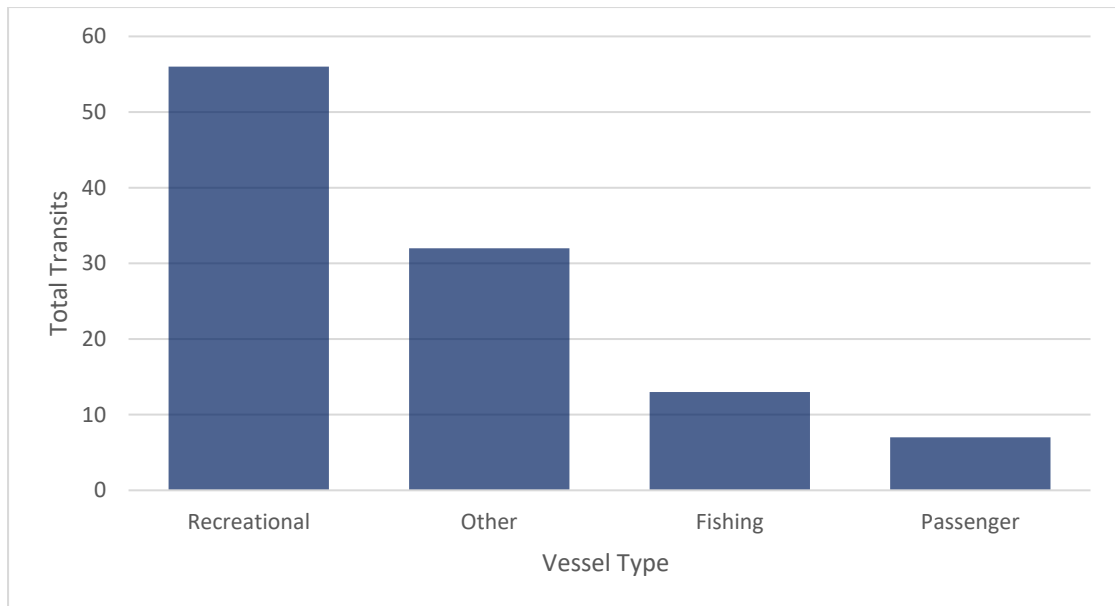


FIGURE 17: FREQUENCY OF TRANSITS BY VESSEL TYPE

Figure 18 demonstrates transits by LOA. The majority (69%) of vessels are less than 14m LOA reflecting the predominance of recreational vessels and other small craft such as; workboats, tugs and survey vessels as represented by the ‘other’ classification. The increase in number of transits with a LOA >85m is a result of the presence of passenger vessels such as *Hebridean Sky* (LOA 90m) and *Corinthian* (LOA 88m).

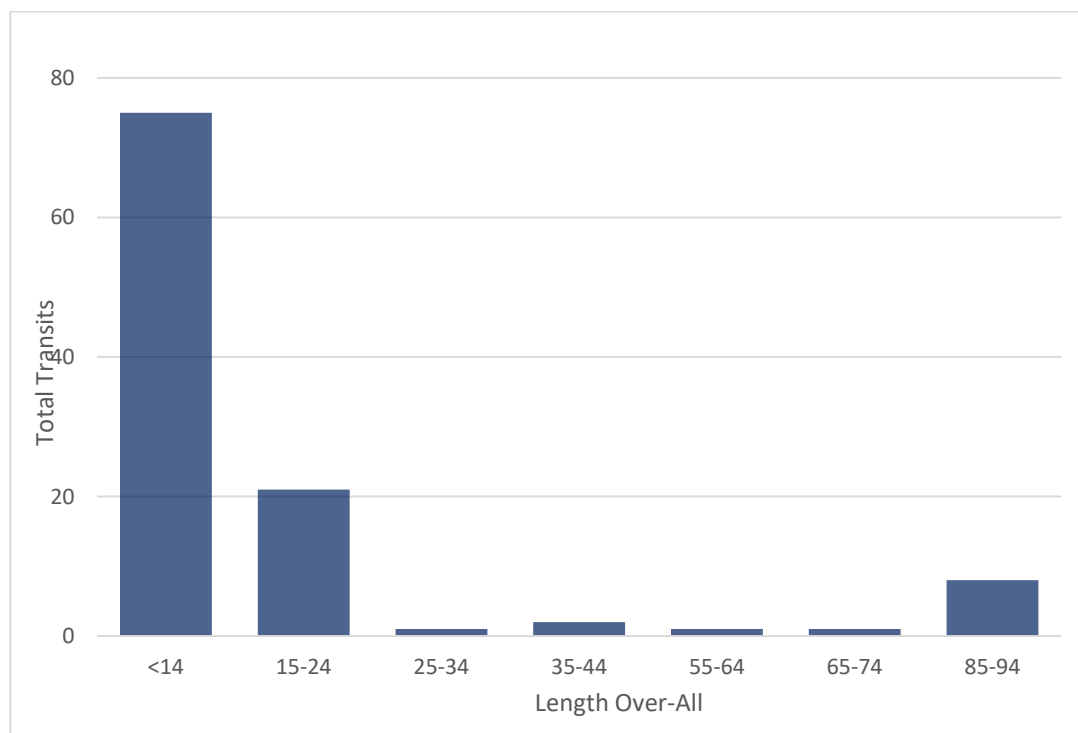


FIGURE 18: VESSEL TRANSITS BY LOA

Transits through the gates were analysed by draught within **Figure 19**. 89% of vessels that transited the gate have a draught of less than 3m. Twelve transits by 6 unique vessels with a draught >3m transited the gate during the two- week data period; of which; one was a buoy laying vessel (draught 4.6m), three were passenger vessels (draught 3.4 to 4.2m), one a survey vessel (3.6m), and one a fishing vessel (draught 3.5m).

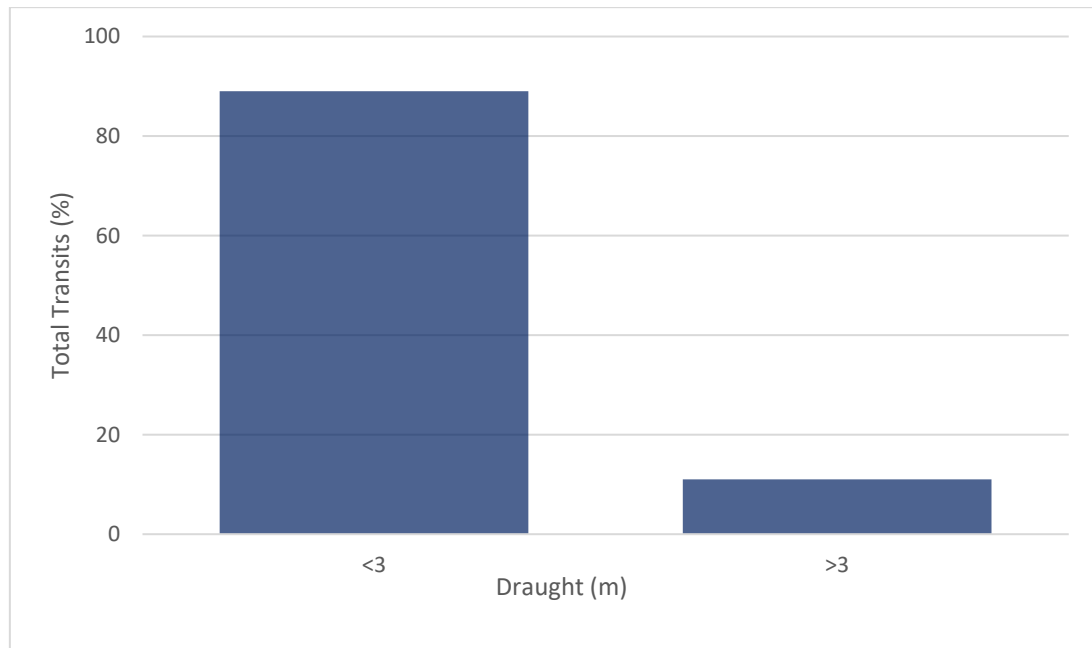


FIGURE 19: VESSEL TRANSITS BY DRAUGHT

6.7 FUTURE VESSEL TRAFFIC LEVELS

Account must be taken of any future changes to the vessel traffic profiles anticipated near to the project site. These changes can be the result of:

- Macro-economic drivers to regional/national economy;
- Localised port developments (new terminals/marinas); and
- Planned alterations of existing activities/routes.

6.7.1 Future Traffic Predictions

In consultation with the Holyhead Harbour Master, the following port development plan was described with the potential to increase traffic within the vicinity of the proposed Morlais Zone:

- Berth extension to enable the handling of more general cargo and larger cruise ships. Dredge material from Holyhead Port likely to be disposed of at Holyhead North disposal site to the west of the Morlais Zone⁹;
- Construction of a berth to support construction activities of nearby Wylfa nuclear power plant. The operator of Wylfa; Horizon Nuclear Power, has additionally planned for sediment and rock disposal at the Holyhead North disposal site to the west of the Morlais Zone(It is noted that It was reported on 17 January 2019 that plans for the construction of the nuclear power station on Anglesey had been suspended).

A final Port Development Plan is planned to be submitted in Q1/19.

⁹ MMO (2017) Scoping Opinion; Port of Holyhead – Holyhead Port Expansion: DC10119

7 HISTORIC INCIDENTS NEAR PROJECT SITE

To support the hazard identification and analysis of the frequency of incidents, a review of the Marine Accident Investigation Bureau (MAIB) incident database was conducted. Historic trends and accident rates within the vicinity of the proposed Morlais Zone and geographic areas of high-risk were analysed and are represented within **Figure 20**.

The MAIB is responsible for the investigation of all types of marine accidents, both to vessels and to those on board. The MAIB is an independent branch within the Department for Transport (DfT) and is separate from the MCA.

Procedures are governed mainly by the Merchant Shipping Act 1995, and by Regulations. The Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 SI No. 1743 came into force on the 31 July 2012. The regulations define accidents, set out the purpose of investigation and make provisions for the ordering and conduct of investigations.

The sole objective of MAIB accident investigations is to determine the circumstances and causes of the accident with a view to preserve life and avoid accidents in the future.

Under the regulations accidents involving or occurring on board any United Kingdom ship must be reported to the MAIB, with some exceptions for leisure vessels and small vessels in inland waterways.

7.1 MAIB ACCIDENT REPORTS

Figure 20 shows marine accidents investigated by the MAIB in proximity to the Morlais Zone between 1997 and 2017. There were a total of 14 separate MAIB incidents recorded within 1nm, of which, one considered navigationally significant; a collision between a recreational dive RHIB and a fishing vessel on 31st August 2015. The incident was described by the MAIB as follows:

‘Collision between a dive RHIB and fishing vessel - A diving boat had divers in the water and was stationary displaying the appropriate flag, when a fishing vessel came towards them at speed and despite seeing the diving vessel did not slow down.’¹⁰

¹⁰ Marine Accident Investigation Branch (2015)

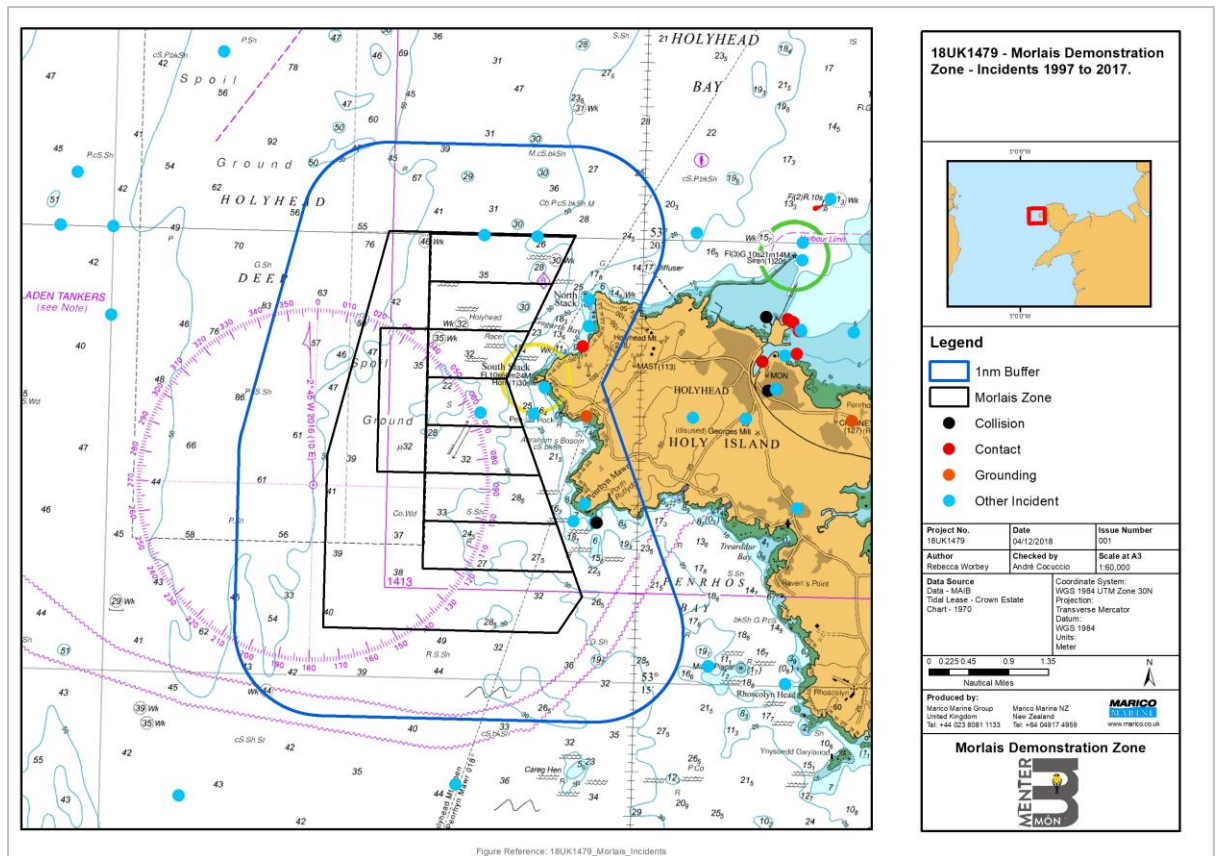


FIGURE 20: MAIB INCIDENTS 1997 – 2017

It was noted during consultation that an incident had occurred at the adjacent Minesto operated Holyhead Deep whereby a yacht made contact with a project buoy resulting in loss of the radar reflector on the buoy and the mast of the yacht.

RNLI Callouts are shown within **Figure 21**. A total of 125 callouts occurred within 1nm of the proposed Morlais Zone, or approximately 16 per year. Of these, 56 callouts (45%) involved recreational vessels, and 10 or 8% involved fishing vessels. 9% of callouts were in response to a person in the water and 25% were in response to persons stranded on the adjacent beach cliffs. One callout was in response to a military vessel that experienced a machinery failure. 23% of callouts reported machinery failure as the cause for assistance. 50% of callouts were answered by Holyhead Lifeboat station and 50% by Trearddur Bay Lifeboat station.

A total of 21 callouts occurred within the Morlais Zone, of which, 12 or 57% were in response to recreational vessels. 50% of callouts within the Morlais Zone occurred in 2008 and 2012, the busiest years for callouts. There were 2 callouts per year between 2014 and 2016 within the Morlais Zone.

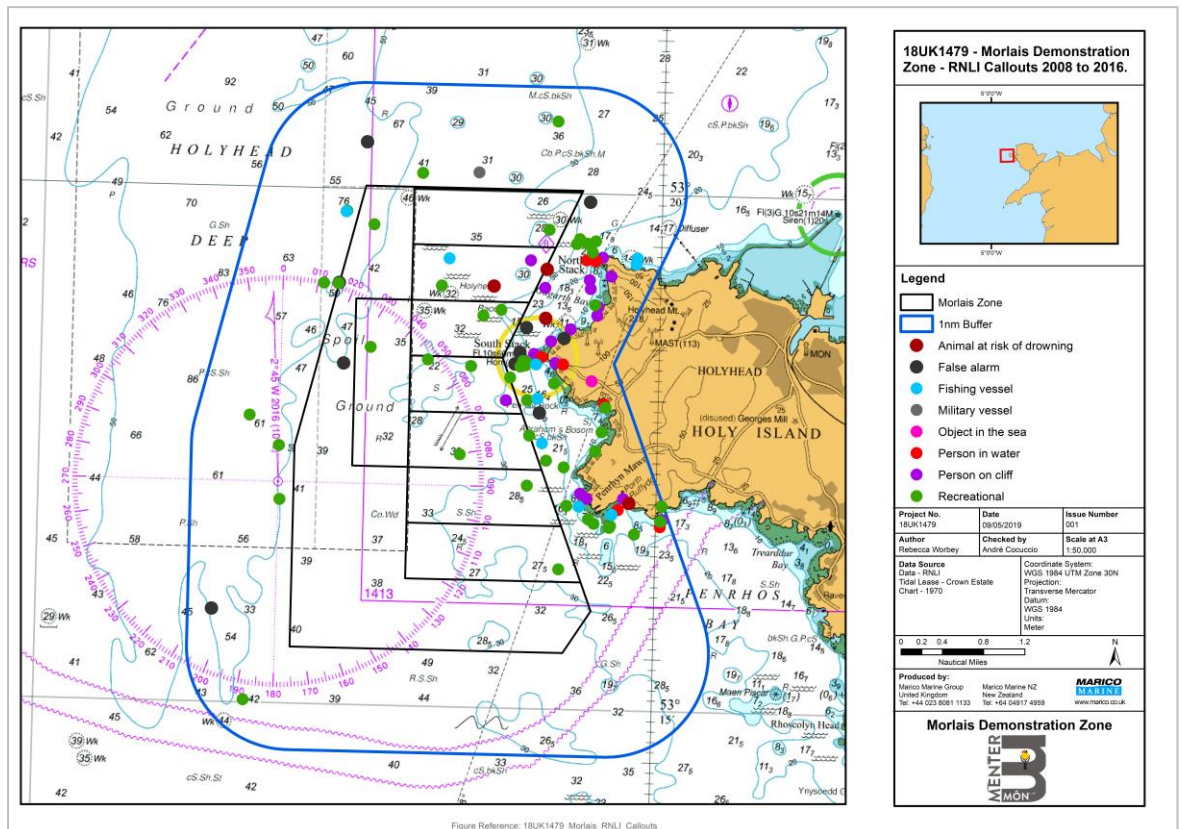


FIGURE 21: RNLI CALLOUTS WITHIN 1NM – 2008 TO 2016.

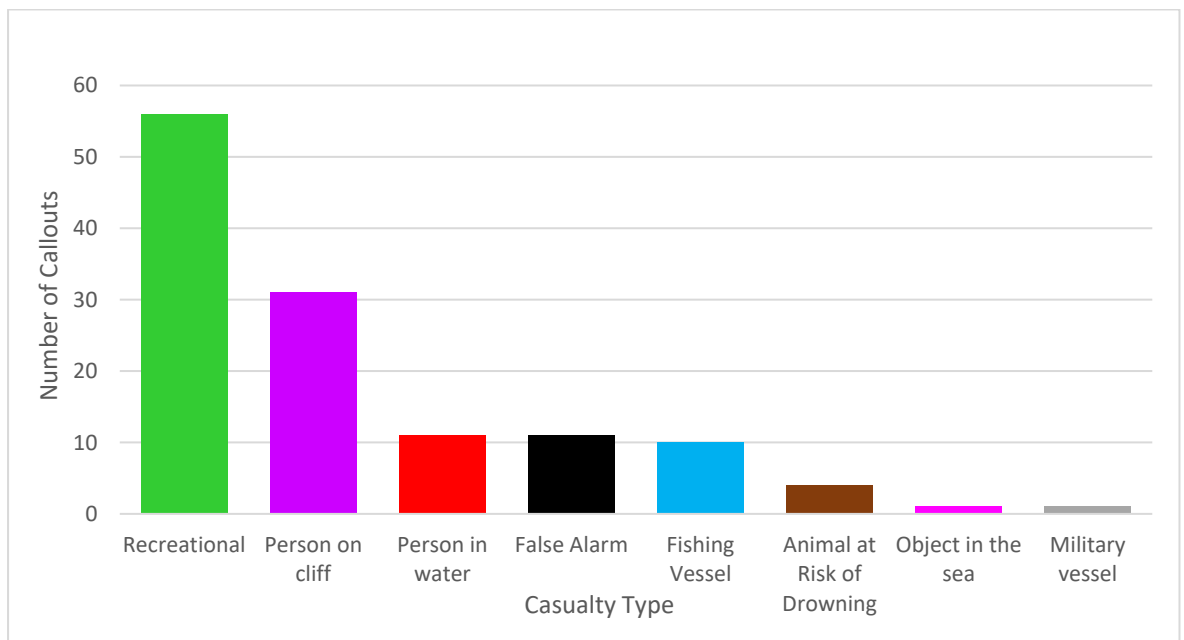


FIGURE 22: RNLI CALLOUTS WITHIN 1NM BY CASUALTY TYPES -2008 TO 2016

8 UNDER KEEL CLEARANCE

Under-Keel Clearance (UKC) is defined as the minimum clearance available between the deepest point on the vessel and the bottom in still water i.e.:

$$\text{UKC} = (\text{Charted Depth of Water} + \text{Height of Tide}) - (\text{Static Draught})$$

The static draught is the “*draught when the vessel is not making way or subject to sea and swell influences*”.

Generally, transits will be planned for any state of tide which, of course, will affect the available depth of water. Two key factors need to be considered when determining the UKC:

- The vertical safety margin between the devices and sea surface; and
- The maximum draught of vessels likely to transit above the device.

8.1 VESSEL DRAUGHTS

Vessel transits through the proposed Morlais Zone by draught between 1st October 2017 and 31st March 2018 are given in **Figure 23**.

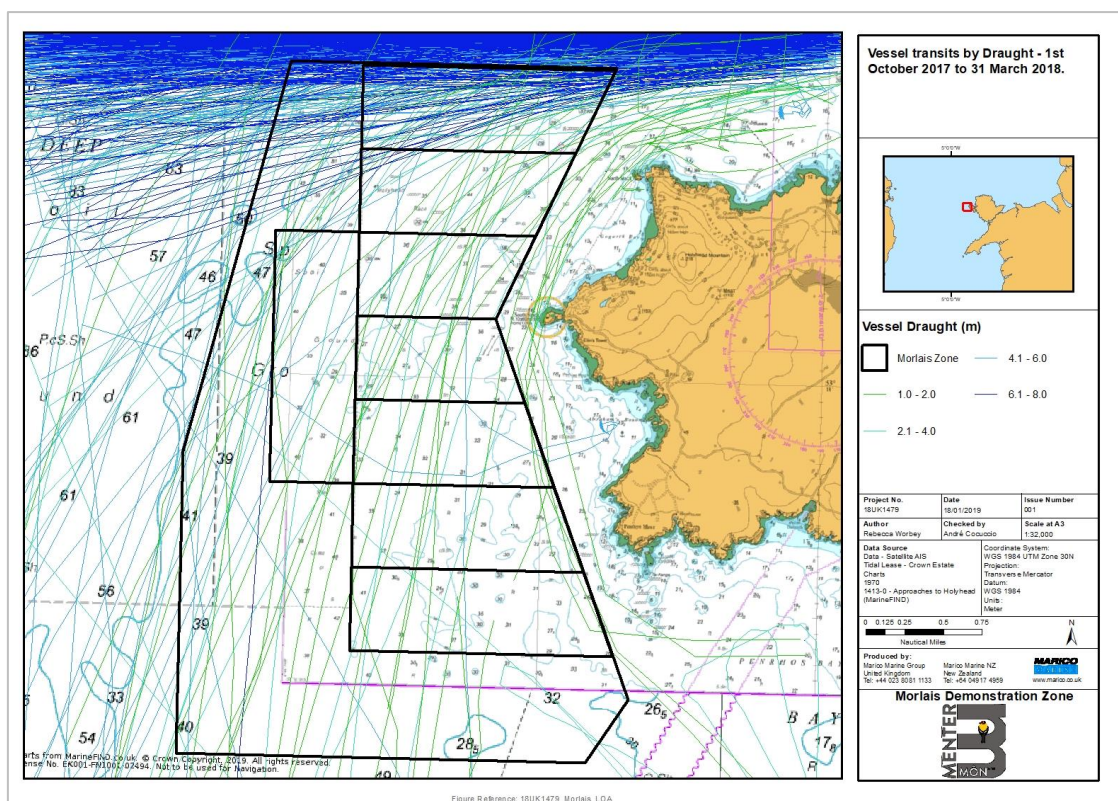


FIGURE 23: TRANSITS BY DRAUGHT (AIS ONLY) - 1ST OCTOBER 2017 AND 31ST MARCH 2018

The top five maximum draught vessels transiting within, or within close proximity to, the Morlais Zone are detailed in **Table 8-1**. None of these vessels transited beyond the northern most two sub-zones and the westernmost sub-zone.

It is noted that the bulk carrier *MV Equator* with a draught of 6.8m was present within the winter 2017 dataset, however, transiting through the TSS away from the Morlais Zone. Additionally, pipe burying vessel *Rockpiper* with a draught of 7.7m was present within the winter 2018 dataset at a distance of 1.6nm from the most NW point of the proposed Morlais Zone. Both vessels were subsequently excluded from the analysis of UKC. The ASD specifies that deep draught vessels should not pass between Careg Hen and the mainland coast near low water.

TABLE 8-1: MAXIMUM DRAUGHTS WITHIN PROPOSED MORLAIS ZONE - 1ST OCTOBER 2017 AND 31ST MARCH 2018

Vessel	Vessel Type	Static Draught (m)
CORNELIS VROLIJK FZN	Fishing Vessel	6.8
OSCAR WILDE	Passenger Vessel	6.7
SUPERFAST X	Passenger Vessel	6.6
ULYSSES	Passenger Vessel	6.5
STENA HORIZON	Passenger Vessel	6.5

In accordance with the MCA Under Keel Clearance Policy Paper¹¹, *‘where there is no safe and reasonable deviation for marine traffic using the area, Under Keel Clearance (UKC) over tidal turbines or other man made under water obstructions must allow for the safe transit of vessels at all states of tide.’*

In open waters a larger UKC allowance is necessary in order that the dynamic movement of the vessel while underway (pitching, rolling, heeling and vertical heave) as a result of swell, sea waves and wind. The available depth of water is, in addition, impacted by the height of tide and, therefore, UKC calculations should consider the worst case - Low Water (LW) tidal conditions considered to be Chart Datum (CD).

In order to ascertain UKC that would allow maintained and safe navigation within the proposed Morlais Zone, feedback was received during local consultation in relation to vessel UKC which is summarised within **Table 8-2**.

¹¹ MCA -Guidance To Developers in Assessing Minimum Water Depth over Tidal Devices (2014) Guidance to Developers in Assessing Minimum Water Depth over Tidal Devices.

TABLE 8-2: CONSULTATION FEEDBACK – UNDER KEEL CLEARANCE (UKC)

Consultee	Feedback
Recreational	<ul style="list-style-type: none"> • Large racing yachts have a draught of <2.5m. Therefore, in good weather if devices are >3m below CD then most would be able to transit above them. • In poor weather safe UKC will increase to allow for wave heights. In this case a minimum of 6-7m is recommended.
RNLI	<ul style="list-style-type: none"> • RNLI vessels draw 2m, 6-7m in bad weather (assuming worst case wave height). • RNLI considers 6-8m under keel clearance is necessary for small vessels (<2.5m draught) to navigate safely over submerged devices in all states of tide and weather conditions.
Fishing	<ul style="list-style-type: none"> • Required UKC should allow for worst case wave height and vessel draught. • 8m minimum UKC will be required for fishing vessels to navigate over mid-water devices.
Holyhead Harbour Master	<ul style="list-style-type: none"> • Stena and Irish Ferries' vessels require approximately 20m to safely navigate at all states of the tide and in all weather conditions.
Stena Line	<ul style="list-style-type: none"> • Normal draught is 6m. In bad weather pitch is 6m greater = 12m at mean low water springs. • Passage planning is therefore outside of the 15m contour. • A midwater device at 15m should therefore not cause an issue.
Irish Ferries	<ul style="list-style-type: none"> • An adequate UKC to allow continued navigation would be 2 x draughts below the keel (total 3 draughts). This would result in a 20m minimum clearance as with Minesto.

8.2 UKC SUMMARY

Consultation and vessel draught analysis has established two critical minimum UKC values required in order to maintain continued and safe navigation as outlined within **Table 8-3**.

TABLE 8-3: MINIMUM UNDER KEEL CLEARANCE

Draught (m)	Minimum UKC
<3	8m
>3m	20m

Where surface or near surface devices are utilised and navigation is, therefore, inhibited, marking of devices in accordance with Trinity House Lighthouse Service (THLS) requirements (see **Section 11**) will be required in order to mitigate contact hazards.

9 NAVIGATION RISK ASSESSMENT METHODOLOGY

Following vessel traffic analysis and stakeholder consultation a risk assessment was undertaken to assess the change in risk during both the construction and operation phases. The risk assessment was conducted in accordance with the International Maritime Organisation (IMO) Formal Safety Assessment (FSA) methodology for risk assessments (see **Figure 24**). A detailed description of the methodology is provided in Annex A – Risk Assessment Methodology.

This NRA was commissioned to assess the impact on navigation potentially caused by the construction of the proposed Morlais tidal demonstration project. The NRA is limited to identifying and quantifying any additional or increased navigational risk resulting from the project. It subsequently identifies possible mitigation measures where appropriate and makes recommendations.

Hazard identification is the first fundamental step in the risk assessment process and was informed by analysis and feedback from stakeholders. Key navigational hazards were identified and grouped with the identified vessel types operational in the vicinity of the Morlais Zone to form the list of potential impacts for assessment. The hazards were then assessed as a factor of likelihood (frequency) and consequence. This approach considered two scenarios; “most likely” and the “worst credible”. The quantified values of frequency and consequence were then combined using the Marico HAZMAN II software to produce a risk score for each hazard and collated into a “Ranked Hazard List”. Risk control measures were then suggested that may reduce the hazard to ALARP (**Section 11**).

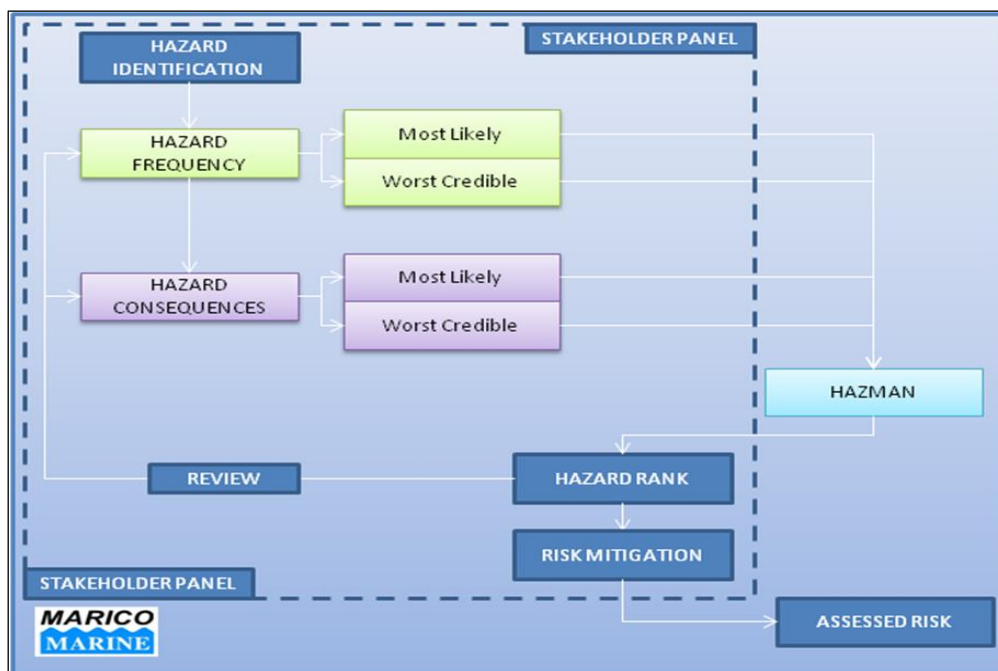


FIGURE 24: MARICO MARINE RISK ASSESSMENT METHODOLOGY

9.1 HAZARD IDENTIFICATION

Hazard Identification was undertaken using the results of the analysis and feedback from local stakeholders. Hazards are determined to be a factor or hazard category, vessel type/ draught and device type/ depth.

The primary hazard categories identified for assessment within the NRA are outlined within **Table 9-1**.

TABLE 9-1: HAZARD CATEGORIES

Ref	Hazard Category	Description
1	Contact	Vessel makes contact with device or buoy.
2	Collision	Transiting vessel collides with another transiting vessel. Including as a result of avoidance of devices.
3	Grounding	Vessel contacts the sea-bed, rocks or cliff.
4	Snagging/ Obstruction	Gear (e.g. fishing gear or anchor) snags on submerged device, mooring arrangements or export cables.
5	Breakout	Device breaks its moorings and becomes a hazard to shipping or runs aground (including during construction works).

In order to focus the assessment of navigation risk within the proposed Morlais Zone, vessel types have been grouped into vessel categories outlined in **Table 9-2**. These categories are a factor of vessel type; established from analysis undertaken within **Section 6: Vessel Traffic Analysis**, and draught; as informed by the assessment of UKC within **Section 8**.

TABLE 9-2: VESSEL CATEGORIES

Ref	Vessel Type Category	Draught	Including
1	Commercial Ship	>3m	Cargo vessels, tankers, dredgers, survey vessels (draught >3m), buoy laying vessels, commercial fishing vessels/ fish carriers.
2	Passenger Vessel	>3m	Ferries, cruise ships
3	Fishing Vessel	<3m	Fishing Vessels

4	Recreational Vessel	<3m	Yachts, power boats, kayaks, canoes
5	Other Vessel	<3m	Tugs and tows, survey vessels, RNLI, construction and maintenance vessels, cable laying vessels.

The device categories considered within the NRA are outlined within **Table 9-3**. Device depths were informed by stakeholder consultation and the assessment of UKC within **Section 8**.

TABLE 9-3: DEVICE CATEGORIES

Ref	Device Category	UKC (m)
1	Surface Devices	0
2	Mid-Water Devices	<8
3	Mid-Water Devices	>8
4	Sea-Bed Devices	>20

46 individual hazards were identified for assessment within the NRA. These hazards were assessed according to two distinct project phases; operation and construction. A full list of hazard categories is located within Annex B – Hazard Log – Construction Phase and Annex C – Hazard Log Operational Phase.

9.2 ASSUMPTIONS

The NRA has been undertaken based upon information provided by the client at the time of commencement. The assumptions outlined within **Table 9-4** are applicable to the NRA.

TABLE 9-4:NRA ASSUMPTIONS

Assumption	Description
Utilisation of worst-case maximum capacity (240MW).	The proposed installed capacity of the project was increased in response to industry demand. The project developer is seeking consent for an array of up to 240MW installed capacity.
Any device type may be deployed within any sub-zone.	The Project will install multiple technology types; therefore, the consent application will be based on the Rochdale Envelope approach. Device types will be determined through consideration of

	the direction of future developments and technology.
Maximum 9 x 33 kv export cables.	A series of seabed installed cables will be laid between individual offshore electrical hubs and the landfall location. The cable routes have not yet been determined, however, it is likely they will make landfall at Abrahams Bosom.
Rochdale Envelope Approach.	No defined, device specific layout was provided prior to undertaking the NRA. The application will be based on the Rochdale envelope approach to maintain maximum layout and device flexibility.
Embedded mitigation measures are in place prior to construction.	Embedded mitigation listed within Table 9-5 are assumed to be in place and as such are reflected in the scores.

9.3 EMBEDDED MITIGATION MEASURES

The embedded risk control measures listed within **Table 9-5** were assumed to be in place when scoring the NRA.

TABLE 9-5: EMBEDDED RISK CONTROLS –ASSUMED TO BE IN PLACE FOR THE RISK ASSESSMENT

ID	Embedded Risk Control	Description
1	Compliance with applicable guidance and regulations.	All construction, operational and maintenance operations are to be fully compliant with legislation, guidance and best practice as well as in accordance with up to date written procedures. Adherence to the MCA Guidance on Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response. Adherence to Diving Regulations 1997.
2	Promulgation of information to local stakeholders.	Promulgation of information and warnings through local Notices To Mariners (NTM) and other appropriate Maritime Safety Information (MSI) dissemination methods. Rolling and regular updates during construction phases. Planning and coordination between developer and vessel operators.
3	Selection of appropriate construction and maintenance vessels	Suitable vessels are to be utilised and personnel are to be trained and competent persons. Use of appropriate Personal Protective Equipment (PPE) by personnel.
4	GPS off station alarm / SCADA monitoring system	
5	Incidents and near misses are reported and investigated by developer and operators.	Incidents to be reported to the MAIB in accordance with MGN 564: Marine Casualty and Marine Incident Reporting. ¹²
6	Marked in accordance with Trinity House	Devices to be marked in accordance with MGN 543 and to comply with IALA standards.
7	Surveyed and charted as required by UKHO	It should be determined at what depth below the seafloor export cables are buried to ensure there are no changes to charted depths. Changes to charted depth arising from tidal turbines and the

¹² Marine Accident Investigation Branch (2017) Marine Casualty and Marine Incident Reporting, MGN 564 (M+F)



ID	Embedded Risk Control	Description
		<p>burial depth of cabling should be surveyed and marked on navigational charts. Detailed and accurate hydrographic surveys are required pre and post construction and following decommissioning.</p> <p>Where traffic patterns are altered as a result of installed generating assets - it may be considered necessary that a hydrographic survey of alternate passages be undertaken.¹³</p>
8	Formulation and implementation of an Emergency Response Co-operation Plan (ERCoP)	Creation of an ERCoP with the MCAs Search and Rescue Branch to outline general safety procedures and provide guidance on emergency response procedures in the event of SAR operations. To be in place for the construction phase onwards.
9	Passage plans for construction and maintenance craft	Development of routeing plans between site and offshore base.
10	Consideration of weather and sea state during construction planning	Limit hazardous activities during adverse weather conditions.

¹³Maritime and Coastguard Agency (2016) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) Guidance on UK Navigational Practice, Safety and Emergency Response. MGN 543 (M+F);
Maritime and Coastguard Agency (2014) Hydrography Guidelines for Offshore Developers;
Maritime and Coastguard Agency (2014) Offshore Developers: Post-Construction Hydrographic Guidelines

10 NAVIGATION RISK ASSESSMENT RESULTS

Risk assessments for both the construction and operation phases were conducted. The results of which are given in full in Annex B – Hazard Log – Construction Phase and Annex C – Hazard Log Operational Phase. The assessment was undertaken utilising the FSA¹⁴ five step approach. 46 individual hazards were assessed for both the construction and operation phases.

A summary of the top ten ranked hazards for both construction and operation phases for the Morlais Zone is shown below in **Table 10-2** and **Table 10-3**. A breakdown of the hazard scores for the baseline assessment of risk (i.e. risk with no additional mitigation measures) for each project phase is summarised within **Table 10-1**.

In total 11 hazards and 15 hazards score higher than 4 (low risk) for the construction and operation phases respectively and, as such, the implementation of mitigation measures should be considered (**Section 11**). One hazard; Grounding Recreational Vessel, was scored as significant for both construction and operation phases.

TABLE 10-1: RISK ASSESSMENT RESULTS SUMMARY – CONSTRUCTION AND OPERATIONAL PHASES

Hazard Category	Category Definition	Construction Phase Results	Operation Phase Results
High Risk	Between 9 and 10	0	0
Significant Risk	Between 7 to 8.99	1	1
ALARP	Between 4 to 6.99	14	10
Low Risk	Between 2 to 3.99	19	22
Negligible Risk	Between 0 to 1.99	12	13

¹⁴ International Maritime Organisation (2018) Revised Guidelines for Formal Safety Assessment (FSA) MSC-mepc.2/Circ.12/Rev.2

10.1 CONSTRUCTION / PHASES

The top ten hazards identified for the construction phase of project are shown below in **Table 10-2** , A full list of ranked hazard scores is located within Annex B – Hazard Log – Construction Phase.

TABLE 10-2: TOP TEN HAZARDS - CONSTRUCTION PHASE

ID	Hazard Title	Hazard Detail	Risk Score
39	Grounding Recreational Vessel	A recreational vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings.	7.01
9	Contact Recreational Vessel with Mid-Water Device (<8m below CD)	A recreational vessel contacts with the device	6.04
10	Contact Other Vessels with Mid-Water Device (<8m below CD)	Maintenance Vessel contacts with the device	5.74
8	Contact Fishing Vessel with Mid-Water Device <8m below CD)	A fishing vessel contacts with the device	5.65
5	Contact Other Vessels with Surface Device	Small vessel (including maintenance Vessel) contacts the device	5.37
40	Grounding Other Vessel	An other vessel / contacts seabed, rocks or cliff grounds due to the presence of the devices and their moorings.	5.34
4	Contact Recreational Vessel with Surface Device	A recreational vessel contacts with the device	5.13
35	Collision Other Vessels ICW Other Vessels	An other vessel collides with an other vessel due to the presence of the devices.	5.13

ID	Hazard Title	Hazard Detail	Risk Score
43	Snagging/ Obstruction Fishing Vessel	A fishing vessel's gear/ anchor interacts with a cable or the device and its moorings.	5.13
7	Contact Passenger Vessels with Mid-Water Device (<8m below CD)	A ferry contacts the device	4.87

10.2 OPERATIONAL PHASE

The top ten hazards identified for the operational phase of project are shown below in **Table 10-3**. A full list of ranked hazard scores are located within Annex C – Hazard Log Operational Phase.

TABLE 10-3: TOP TEN HAZARDS - OPERATIONAL PHASE

ID	Hazard Title	Hazard Detail	Score
39	Grounding Recreational Vessel	A recreational vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings.	7.01
9	Contact Recreational Vessel with Mid-Water Device (<8m below CD)	A recreational vessel contacts with the device	6.04
10	Contact Other Vessels with Mid-Water Device (<8m below CD)	Maintenance Vessel contacts with the device	5.74
8	Contact Fishing Vessel with Mid-Water Device (<8m below CD)	A fishing vessel contacts with the device	5.65
4	Contact Recreational Vessel with Surface Device	A recreational vessel contacts with the device	5.13
43	Snagging/ Obstruction Fishing Vessel	A fishing vessel's gear/ anchor interacts with a cable or the device and its moorings.	5.13
7	Contact Passenger Vessels with Mid-Water Device (<8m below CD)	A ferry contacts the device	4.87
33	Collision Recreational Vessel ICW Recreational Vessel	A recreational vessel collides with a recreational vessel due to the presence of the devices	4.69
26	Collision Passenger Vessels ICW Passenger Vessel	A passenger vessel collides with a passenger vessel due to the presence of the devices	4.00

31	Collision Fishing Vessel ICW Recreational Vessel	A fishing vessel collides with a recreational vessel due to the presence of the devices	3.94
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11 SUGGESTED ADDITIONAL RISK CONTROL MEASURES

While the majority of hazards identified and scored for this risk assessment fell into the ALARP or below categories of risk (see Section 9), further mitigation risk control measures should be considered for the hazards assessed as ALARP or above (>4).

Additional risk control measures that have been identified and are recommended in order to ensure safe and efficient operations are listed in Table 11-1. To ensure that the risks remain As Low As Reasonably Practicable (ALARP), the NRA process should be maintained and reviewed as part of the future Morlais Zone Navigation Safety Management System (NSMS) to assess changes to the vessel traffic profile throughout the life of the project.

TABLE 11-1: POSSIBLE ADDITIONAL RISK CONTROL MEASURES

ID	Risk Control	Description	Phase
1	Continuous Monitoring by Marine Co-ordination Centre	Monitoring by radar, AIS, Closed Circuit Television (CCTV) or other agreed means. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones or ATBA.	All Phases
2	Restrict Navigation through the Morlais Zone	For example; via designation of site as an Area To Be Avoided (ATBA) or Precautionary Area (PA). An ATBA is an area within defined limits that should be avoided by all ships or certain classes of ship, in which navigation is particularly hazardous or in which it is exceptionally important to avoid casualties. In general, ATBAs should be established only in places where: inadequate survey or insufficient provision of aids to navigation may lead to danger of stranding; where local knowledge is considered essential for safe passage; where there is the possibility that unacceptable damage to the environment could result from a casualty; or where there may be hazards to a vital aid to navigation. ¹⁵ PA's are defined as areas within defined limits where ships must navigate with particular caution and within which the direction of flow of traffic may be recommended. ¹⁶	All Phases
3	Exclusion of fishing within the Morlais Zone	To prevent fishing gear snagging on underwater devices and their associated infrastructure.	All Phases

¹⁵ International Maritime Organisation (1985) General Provisions on Ships' Routeing, adopted Nov. 20, 1985, IMO Resolution A.572(14).

¹⁶ International Maritime Organisation (1985) General Provisions on Ships' Routeing, adopted Nov. 20, 1985, IMO Resolution A.572(14).

ID	Risk Control	Description	Phase
4	Devices >8m below CD to be deployed along eastern boundary	To maintain safe navigation within the inshore route for small, primarily recreational vessels (draught <3m).	Operational
5	Devices >20m below CD to be deployed within Zones 1,2 and 8	To maintain navigation of fair weather and poor weather ferry routes.	Operational
6	Re-design eastern boundary	To maintain safe navigation within the inshore passage during all sea states, weather and at night.	Operational
7	Appropriate alignment and spacing of devices	The MCA has statutory obligations to provide Search and Rescue services in and around OREIs in UK waters. Device layout designs must be designed to ensure clear lines of sight and navigation allow safe transit by rescue craft and those vessels that decide to transit through them including during poor visibility, high sea states and at night. ¹⁷	Operational
8	Check device surveys	To ensure devices remain at the stated charted depth. Changes to charted depth arising from tidal turbines should be surveyed and marked on navigational charts.	Operational
9	Guard vessel to monitor passing traffic	To prevent a vessel contacting a device / partially constructed device during construction / installation. To keep watch and warn vessels that may be in danger, for example, to prevent a collision as a result of third-party avoidance.	Construction
10	Establish no anchoring areas	No anchoring areas to be established around nearshore cable route.	All Phases
11	Enhanced cable protection	If burial is not possible, for example due to underwater features and/or seabed ground conditions export cables should be suitably protected such as by rocks or other such suitable mattress placements to mitigate the	All Phases

17 Maritime and Coastguard Agency (2016) Safety of Navigation: Offshore Renewable Energy Installations (OREIs) Guidance on UK Navigational Practice, Safety and Emergency Response. MGN 543 (M+F); 3. Collision Avoidance and Visual Navigation.

ID	Risk Control	Description	Phase
		risks to the cable and vessels. The MCA would be willing to accept up to 5% reduction in surrounding charted depths referenced to Chart Datum, unless developers are able to demonstrate evidence that any identified risks to any vessel type are satisfactorily mitigated. ¹⁸	
12	Implementation of Safety Zones	Safety zones of appropriate configuration, extent and application; typically: 500m during construction, extension, maintenance or decommissioning and 50m during operation.	Construction
13	Construction vessels to be marked in accordance with COLREGS	To ensure that construction craft remain visible at all times and to ensure passing craft are aware of construction activities.	Construction
14	Temporary navigation aids as required by Trinity House	Temporary marking, lighting and buoyage should be utilised during construction phase in accordance with Trinity House requirements.	Construction
15	Undertake Device Specific Risk Assessments	Further site-specific assessments should be undertaken to build on previous assessments and assess the proposed locations of individual turbine devices, substations, platforms and any other structure within the tidal array. This assessment should include the potential impacts the proposed location may have on navigation and SAR activities and should be undertaken in liaison with the MCA. Additionally, this assessment should consider the tow / delivery of devices to and from the site.	Operational

¹⁸ MGN 543

12 CUMULATIVE IMPACTS

Cumulative impacts refer to the impact upon receptors, proposed developments and activities and any other foreseeable project proposals arising from the presence of the Morlais Zone.

The approach to cumulative assessment considers the Cumulative Impact Assessment Guidelines issued by RenewableUK in June 2013¹⁹.

In assessing the potential cumulative impacts, it is important to bear in mind that proposed and in development projects may or may not actually be taken forward. Relevant projects/ plans that are already under construction are likely to contribute to cumulative impact, whereas projects/ plans not yet approved or not yet submitted are less certain to contribute to such an impact, as some may not achieve approval or may not ultimately be built.

Projects that were identified and informed this approach are outlined within **Table 12-1**.

TABLE 12-1 : CUMULATIVE IMPACTS

Development Type	Project	Distance from Morlais (km)	Status
Tidal	Holyhead Deep	1	In Development
Tidal	Skerries Tidal Energy	11.4	Lease Expired
Oil and Gas	P2292	61	Operational
Wind Farm	Rhyl Flats	66	Operational
Wind Farm	Gwynt y Mor	67.5	Operational
Wind Farm Extension	Gwynt y Mor	67.5	Proposed

¹⁹Renewable UK (2013). Cumulative Impact Assessment Guidelines.

Development Type	Project	Distance from Morlais (km)	Status
Wind Farm	North Hoyle	81.5	Operational
Aggregate Extraction	Area 457	70	Operational
Aggregate Extraction	Area 392 / 393	73	Operational

For the purposes of the cumulative assessment, the Holyhead Deep low-flow Tidal project with an aspirational maximum total installed capacity of 80MW, is the only project considered to fall within the assessment study area, and as such the impact assessment has been driven by the cumulative impacts arising from this site. The assessed scenario is, therefore, outlined in **Table 12-2**.

TABLE 12-2: ASSESSED SCENARIO

Impact	Scenario	Justification
Cumulative Impact due to Increased Vessel Activity	Multiple offshore developments require construction and maintenance vessel activity as they transit to and from their bases of operation.	Potential increases in collision risk.
Cumulative Impact on Vessel Routeing	Commercial shipping, fishing boats and recreational craft must all operate to avoid these developments and any works taking place. This reduces the available sea room available, concentrating them in smaller areas, potentially bringing them into conflict.	Change in vessel routeing across multiple sites due to multiple developments.
Cumulative Impact from Cable Routes	Multiple cable routes that cross over one another may reduce the navigable depth of water.	Reduction in depth and increased maintenance works vessels.

The results of the cumulative risk assessment are given in **Table 12-1**. The determination of risk was assessed to be a factor of the likelihood of the impact occurring and the consequence, should it occur. The criteria of frequency and consequence and risk score definitions are outlined within the risk assessment methodology (Annex A – Risk Assessment Methodology).

TABLE 12-3: CUMULATIVE RISK ASSESSMENT

Impact	Description	Likelihood	Consequence	Risk Score	Impact
Impact from increased vessel Activity	Vessels associated with the Morlais and Holy Head Deep projects may interact with one another. The level of additional vessel activity from each project will be higher during construction and decommissioning. This has the potential to increase collision risk.	Unlikely	Minor	2	Low Risk
Impact on Vessel Routeing	The cumulative impact of these developments will result in a loss of navigable sea room which may require vessels to be rerouted which has the potential to increase the risk elsewhere. Primary cumulative impacts to routeing are the inshore passage and impact upon vessels such as ferries utilising the northern ferry route, search and rescue and Holyhead Deep maintenance vessels.	Unlikely	Minor	2	Low Risk
Impact from Cable Route	The cables are to be unburied with cable protection. Multiple cable routes are required for the project, which may result in a decrease in the charted depth in some areas and an increase in vessel activity during the construction and decommissioning phases.	Unlikely	Minor	2	Low Risk

12.1 CUMULATIVE ASSESSMENT SUMMARY

The risk as a result of cumulative impacts driven by the proximity of the proposed Morlais Zone to existing projects and associated infrastructure is determined to be low risk, as outlined within **Table 12-3**. As such, cumulative impact specific risk controls in addition to those recommended within the project specific risk assessment are not proposed.

It is however, recommended, that communication with the Minesto Holyhead Deep Tidal Demonstration project be maintained to ensure effective procedures are in place to reduce risks that may result from project interactions.

13 CONCLUSIONS AND RECOMMENDATIONS

13.1 CONCLUSIONS

This NRA has assessed the baseline navigation conditions of both the area encompassing and the proposed Morlais Zone. Changes to navigation risk that may result through the construction and operation of the Morlais Zone have been identified and risk assessed. The following conclusions were drawn:

13.1.1 Baseline Marine Environment

1. The Morlais Zone is located 500m offshore of South-Stack in an area of significant tidal flow with maximum spring flow rates of up to 5 knots.
2. Met-ocean conditions can be significant with south-westerly gales are considered the most severe. Waves greater than 5m are rare within the vicinity of the proposed Morlais Zone. The roughest seas are experienced with winds from between the south and north-west.
3. Baseline vessel traffic was assessed:
 - a. Generally, traffic levels are low with approximately 8 transits per day through the east-west gate during in summer;
 - b. There is very little commercial shipping within or close to the Morlais Zone. Tankers and large cargo vessels utilise the Off Skerries TSS;
 - c. The primary large vessel (draught >3m) impacted by the Morlais Zone was identified to be ferries operating along the ferry route to the north (Holyhead to Dublin) which intersects the northern-most subzone;
 - d. Poor weather routes are utilised which intersect the two northern-most sub-zones and the western-most sub-zone. There is one example of a ferry; *Epsilon*, anchoring at Abrahams Bosom on 3rd March 2018;
 - e. Fishing is primarily by small vessels and occurs in and around the Morlais Zone, with potting activities close to shore. Fishing effort is generally low at <20,000 kWh per year; and
 - f. The inshore route is used primarily by recreational craft which intersect the eastern boundary of the Morlais Zone. Recreational vessel traffic increases significantly in summer.

4. Analysis of MAIB incidents identified 14 separate MAIB incidents within 1nm of the Morlais Zone, of which, one is navigationally significant; a collision between a recreational motor boat and a dive boat.
5. RNLI callouts were assessed. 125 callouts occurred in the 8 years from 2008 to 2016, or approximately 16 per year. 45% of callouts were in response to recreational vessels.
6. One OREI was identified within close proximity to the site; the Minesto operated Holyhead Deep tidal site.

13.1.2 Navigation Risk Assessment

1. 46 individual hazards were identified for assessment within the NRA. These hazards were assessed according to two distinct project phases; operation and construction;
2. The majority of hazards were scored to be low-risk;
3. 11 and 15 hazards scored higher than 4 (low risk) for the construction and operation phases respectively;
4. Ferries maintain up to date charts, have experienced crew, and are used to operating within the area and as such hazards involving the contact of ferries with all devices were scored as ALARP. (Note: this assumes the Morlais Zone / devices will be marked and charted according to Trinity House requirements);
5. Risk scores of small vessels (<3m draught) were driven by the reduction in sea room as a result of the narrowing of the inshore passage and an increase of vessels utilising the inshore passage in order to navigate around the site;
6. One hazard; 'Grounding Recreational Vessel', was scored as significant for both construction and operation phases and is, therefore, deemed unacceptable in the absence of additional mitigation. The score was driven by the restriction of sea room within the inshore passage increasing the risk of a recreational vessel contacting the cliffs which could result in loss of life
7. It is considered that the score of: *'Snagging/ Obstruction: Fishing Vessel: A fishing vessel's gear/ anchor interacts with a cable or the device and its moorings'* (5.13 - ALARP) under-represents the risk to people and the project as a result of a minimal impact to the environment should this hazard occur;
8. Cumulative impacts driven by the proximity of the proposed Morlais Zone to existing projects and associated infrastructure were assessed and determined to be low risk.

13.2 RECOMMENDATIONS

The specific mitigation and safety measures to be employed should be selected in consultation with the MCA and listed in the developer's safety manual or Safety Management System. These will be consistent with international standards contained in, for example, the Safety of Life at Sea (SOLAS) Convention - Chapter V, IMO Resolution A.572 (14)³ and Resolution A.671(16).

The risk control measures summarised within **Table 13-1** were identified to reduce risk and as such, it is recommended that consideration be given to their implementation. (A full description of risk control measures is located within **Section 11**).

It is recommended that risk control measures be considered for all hazards scoring above 4: Low Risk.

TABLE 13-1: POSSIBLE ADDITIONAL RISK CONTROL MEASURES.

ID	Risk Control	Phase	
		Construction	Operation
1	Continuous Monitoring by Marine Co-ordination Centre	X	X
2	Restrict Navigation through the Morlais Zone	X	X
3	Exclusion of fishing within the Morlais Zone	X	X
4	Devices >8m below CD to be deployed along eastern boundary		X
5	Devices >20m to be deployed within Zones 1,2 and 8		X
6	Re-design eastern boundary		X
7	Appropriate alignment and spacing of devices		X
8	Check device surveys		X
9	Guard vessel to monitor passing traffic	X	
10	Establish no anchoring areas	X	X
11	Enhanced cable protection	X	X
13	Implementation of Safety Zones	X	
14	Construction vessels to be marked in accordance with COLREGS	X	
15	Temporary navigation aids as required by Trinity House	X	
18	Undertake Device Specific Risk Assessments		X

1. Two critical depths were established through consultation in order to ensure continued safe navigation through the Morlais Zone:
 - a. A minimum 8m UKC would be required to ensure continued safe navigation of vessels draught < 3m through the Morlais Zone;
 - b. A minimum UKC of 20m would be required to ensure continued safe navigation of ferries and vessels draught > 3m through the Morlais Zone. Ferry alternative poor weather routes intersect the two northern most sub-zones and the westernmost sub-zone of the Morlais Zone. It is therefore recommended that an UKC of > 20m be maintained within these sub-zones, or alternative routes be provided to ensure safe passage during adverse weather conditions.
2. In the UK all vessels have freedom to transit through OREIs, subject to any applied safety zones and their own risk assessments. Where surface or near surface devices are installed at a depth that does not allow the minimum UKC to be maintained, marking of devices in accordance with TH requirements (see **Section 11**) will be required in order to mitigate contact hazards.
3. The hazard Grounding: Recreational Vessel Mitigation measures are required to reduce the risk of 'Grounding: Recreational Vessel' was scored as significant. The following mitigation measures should be considered to reduce this hazard to ALARP:
 - a. Devices > 8m below CD to be deployed along the eastern boundary; or
 - b. Redesign eastern boundary.
4. Although scored as ALARP (5.13) driven by a low environmental and vessel consequence score it is considered that the hazard '*Snagging/ Obstruction: Fishing Vessel: A fishing vessel's gear/ anchor interacts with a cable or the device and its moorings*' cannot be mitigated to a level that would reduce the risk to people and the project to acceptable levels and, as such, it is recommended that fishing be excluded within the Morlais Zone.

13.2.1 Ongoing Risk Assessment

1. The NRA process should be an on-going process throughout the life of the project taking into account changes in traffic densities and other factors that may affect the hazard regime. Continuous review of the navigation risk assessment to ensure that it remains up to date and fit-for-purpose is advised;
2. It is a requirement of MGN 543 that a review of the NRA should be carried out post-consent and prior to construction to validate the Environmental Statement (ES). This

may include additional traffic survey data and assess any changes to plans that could impact navigation. It is, therefore, recommended the NRA be reviewed once a layout and construction methodology has been finalised;

3. Site and device specific assessments should be undertaken to assess the proposed locations of; individual turbine devices, substations, platforms and any other associated structures. This should include:
 - a. An assessment of device specific impacts to navigation and SAR activities, undertaken in liaison with the MCA;
 - b. Assessment of the passage plans for tow / delivery of devices to and from the site;
 - c. An assessment of mooring arrangements in accordance with MCA and HSE Guidance²⁰, including third-party verification;
 - d. Review of device specific marking and lighting to be approved by Trinity House and in consultation with MCA;
 - e. Device specific decommissioning plan;
 - f. Device specific assessment of UKC;
 - g. A review of the impact to communications RADAR and positioning systems arising from the presence of the device;
 - h. A review of the impact cable routes once locations are finalised;
 - i. A review of site wide risk controls; and
 - j. Device specific risk control recommendations.

²⁰ MCA, HSE (2017) Regulatory Expectations on Moorings for Floating Wind and Marine Devices

ANNEX A – RISK ASSESSMENT METHODOLOGY

Introduction

The Navigation Risk Assessment was undertaken in accordance with the guidance set out in MGN 543: Safety of Navigation: Offshore Renewable Energy Installations – Guidance on UK Navigational Practice, Safety and Emergency Response.

Consultation

National

Consultation with national stakeholders was undertaken in accordance with MGN 543 and included the MCA, Chamber of Shipping and Trinity House.

Local

Local consultation was undertaken with representatives from the stakeholder groups outlined in Table 0-1 in order that local knowledge and opinion informs the assessment of risk.

TABLE 0-1: LOCAL CONSULTEE GROUPS

Vessel / Activity Type	Description
Recreational Vessel Organisations	To establish overall recreational use of the area e.g. Cruising routes and whether racing takes place within the project area.
Fishing Vessel Organisations	To establish the fishing intensity and types of activity within the project area - identification of any potential impacts resulting from fishing activity e.g. Cable snagging as result of trawling activities.
Port and Navigation Authorities	For example; Holyhead Harbour Master To ascertain local knowledge pertaining to vessel usage of the study area/ surrounding area. Establish if any navigational issues exist.
Search and Rescue	E.g. Local Coastguard and RNLI. To establish if any navigational issues exist and identify any notable incidents / high risk areas. To ascertain the potential effects of the demonstration site on SAR operations in the area.

Vessel / Activity Type	Description
Commercial Vessel Operator	To establish the impact of the site on commercial shipping routes, particularly high-use e.g. Ferry routes. (Including discussions with a ferry Master)

Data Analysis

Baseline Environment and Traffic Profile

Detailed data analysis of AIS and radar data was undertaken in order to understand the baseline environment and traffic profile. This included the assessment of vessel; numbers, types, draught and sizes and the assessment of the vessel and device types set out in Section 9.1.

TABLE 0-2: ASSESSMENT OF VESSELS TYPES AND BASELINE ENVIRONMENT

Vessel / Activity Type	Description
Commercial Vessels	To assess whether transit routes and shipping lanes used by coastal or deep-draught vessels on passage exist within proximity of the site. Identification of any nearby prescribed routeing schemes, precautionary areas or separation schemes.
Non-Transit Uses	For example; fishing, day cruising of leisure craft, racing, surveying and aggregate dredging.
Anchoring	Proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas.
Fishing Vessels	Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds.
Military Vessels / Ranges	Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes.

Vessel / Activity Type	Description
OREI developments,	Proximity of the site to existing or proposed OREI developments, in co-operation with other relevant developers, within each round of lease awards.
Spoil Sites	Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground
Aids to Navigation / VTS	Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon.

Changes to Charted Depths

Project structures, to include tidal devices and cables were assessed to identify if inter-device and export cabling could pose any type of difficulty or danger to vessels underway, performing normal operations, including fishing, anchoring and emergency response. This included an assessment of Under Keel Clearance (UKC) and changes to charted depths as a result of underwater devices and cables.

Met-Ocean Conditions

The effect of Met-Ocean conditions on navigation was considered in accordance with Annex 2 of MGN 543. This considered primarily the effect of the tidal stream on vessel routing.

Incidents

The number and type of incidents to vessels which have taken place in or near to the proposed site of the OREI was assessed to ascertain the likelihood of such events in the future and the potential impact of such a situation to inform the assessment of hazard frequency.

Risk Assessment

The NRA process proposed is based on Formal Safety Assessment (FSA) methodology as adopted by IMO and follows the guidance set out in International Best Practise. Marico Marine uses a form of risk assessment that has been specifically adapted for navigational use. It is unique to Marico and is fundamentally based on concepts of “Most Likely” and “Worst Credible”, which reflects the range of outcomes arising from a shipping accident.

The results of the analysis and consultation with stakeholders would be used to identify hazards associated with the project. These hazards were scored for their

likelihood and consequence and a ranked hazard list of the greatest hazards was produced using our risk management software Hazman (**Figure 25**). Additional mitigation has been identified and recommended to ensure the risks are As Low As Reasonably Practicable (ALARP).

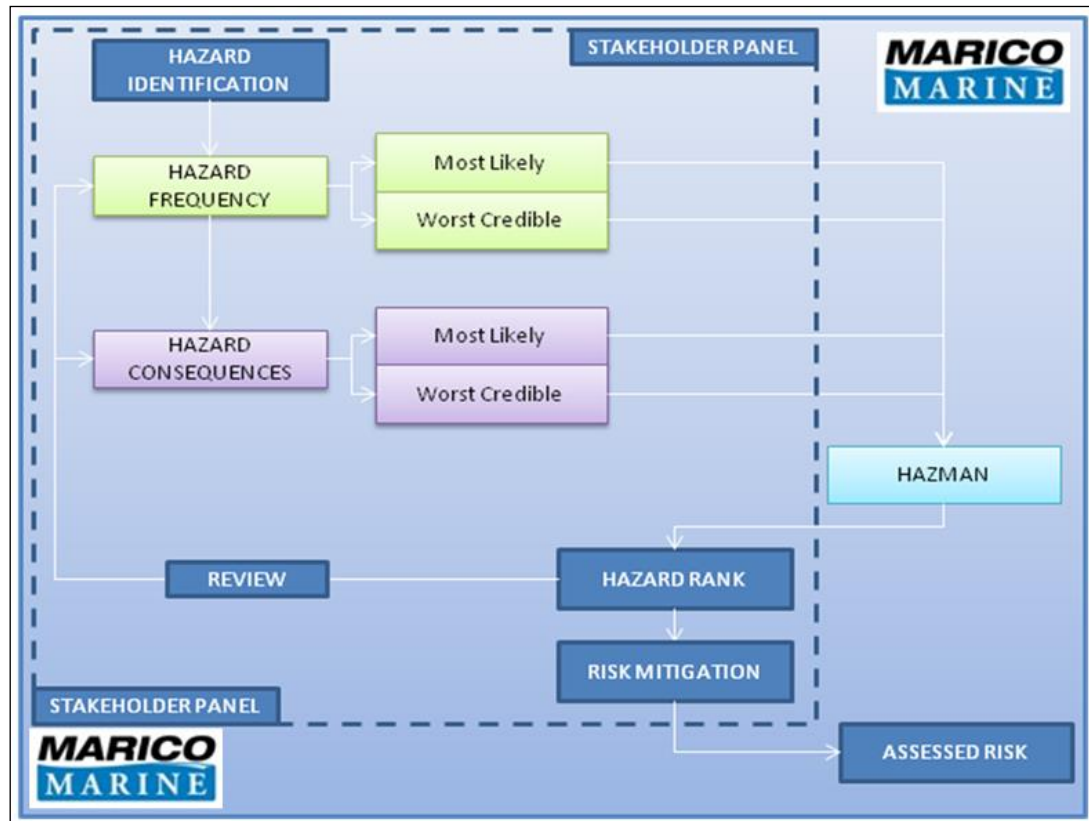
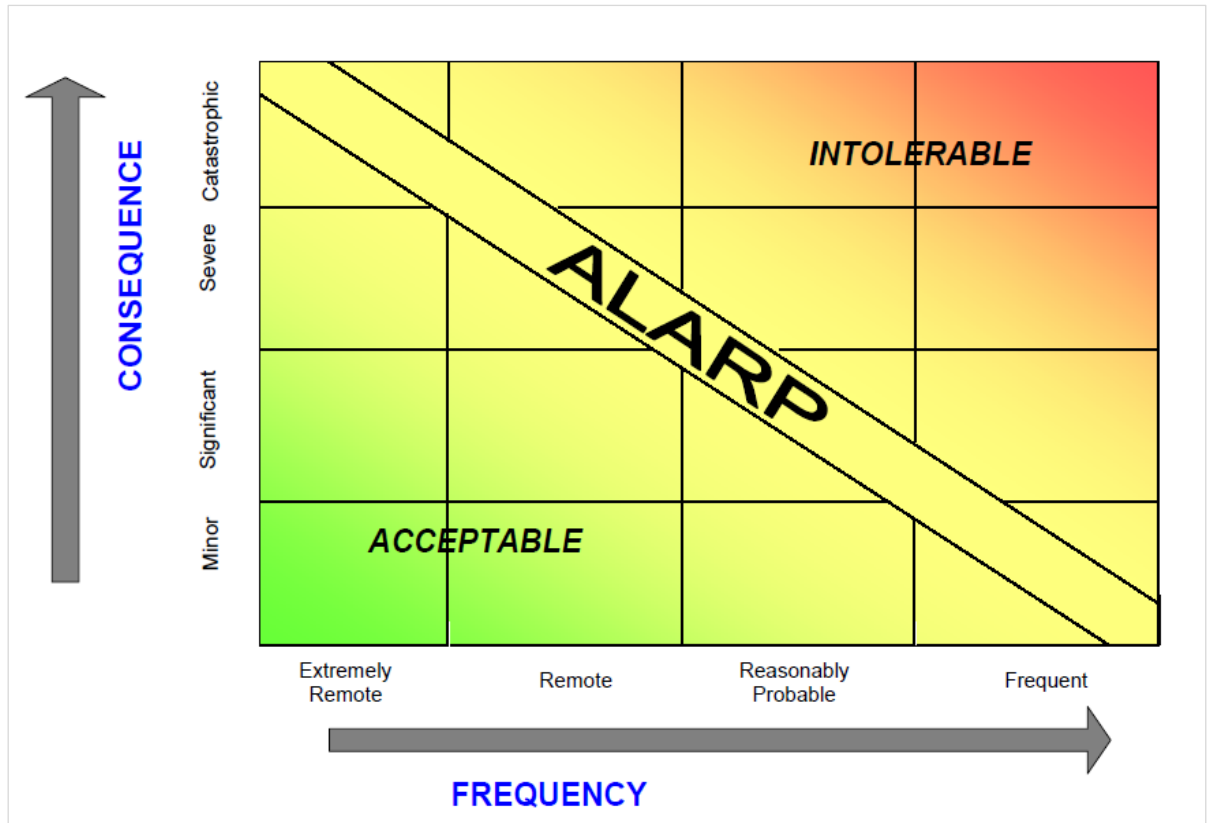


FIGURE 25: MARICO HAZARD IDENTIFICATION AND RISK ASSESSMENT PROCESS.

Criteria for Navigational Risk Assessment

Risk is the product of a combination of consequence of an event and the frequency with which it might be expected to occur. In order to determine navigational risk a Formal Safety Assessment (FSA) approach to risk management is used. International Maritime Organisation (IMO) Guidelines define a hazard as “something with the potential to cause harm, loss or injury”, the realisation of which results in an accident. The potential for a hazard to be realised can be combined with an estimated or known consequence of outcome. This combination is termed “risk”. Risk is therefore a measure of the frequency and consequence of a particular hazard.



GENERAL RISK MATRIX.

The combination of consequence and frequency of occurrence of a hazard is combined using a risk matrix which enables hazards to be ranked and a risk score assigned. The resulting scale can be divided into three general categories:

1. Acceptable;
2. As Low as Reasonably Practicable (ALARP); and
3. Intolerable.

At the low end of the scale, frequency is extremely remote and consequence minor, and as such the risk can be said to be “acceptable”, whilst at the high end of the matrix, where hazards are defined as frequent and the consequence catastrophic, then risk is termed “intolerable”. Every effort should be made to mitigate all risks such that they lie in the “acceptable” range. Where this is not possible, they should be reduced to the level where further reduction is not practicable. This region, at the centre of the matrix is described as the ALARP region. It is possible that some risks will lie in the “intolerable” region, but can be mitigated by measures, which reduce their risk score and move them into the ALARP region, where they can be tolerated, albeit efforts should continue to be made when opportunity presents itself to further reduce their risk score.

The FSA methodology used in this NRA, determines where to prioritise risk control options for the navigational aspects of a project site. The outcome of this risk assessment process should then act as the basis for a Navigation Safety Management System, which can be used to manage navigational risk.

Hazard Identification

Hazard identification is the first and fundamental step in the risk assessment process and was undertaken using the results of the analysis and feedback from local stakeholders.

The project phases were assessed individually due to their different navigational risk exposure and magnitude, i.e. the different nature of the operations, the vessels involved, and the potential cost of any consequences.

Risk Matrix Criteria

Frequency of occurrence and likely consequence are both to be assessed for the “most likely” and “worst credible” scenario. Frequencies were assessed according to the levels set out below.

TABLE 0-3: FREQUENCY CRITERIA

Scale	Description	Definition	Operational Interpretation
F5	Frequent	An event occurring in the range once a week to once an operating year.	One or more times in 1 year
F4	Likely	An event occurring in the range once a year to once every 10 operating years.	One or more times in 10 years 1 - 9 years
F3	Possible	An event occurring in the range once every 10 operating years to once in 100 operating years.	One or more times in 100 years 10 – 99 years
F2	Unlikely	An event occurring in the range less than once in 100 operating years.	One or more times in 1,000 years 100 – 999 years
F1	Remote	Considered to occur less than once in 1,000 operating years (e.g. it may have occurred at a similar site, elsewhere in the world).	Less than once in 1,000 years >1,000 years

Using the assessed notional frequency for the “most likely” and “worst credible” scenarios for each hazard, the probable consequences associated with each was assessed in terms of damage to:

1. People - Personal injury, fatality etc.;
2. Property – Project and third party;
3. Environment - Oil pollution etc.; and
4. Business - Reputation, financial loss, public relations etc.

TABLE 0-4: CONSEQUENCE CATEGORIES AND CRITERIA.

Cat.	People	Property	Environment	Business
C1	Negligible Possible very minor injury (e.g. bruising)	Negligible Costs <£10k	Negligible No effect of note. Tier1 may be declared but criteria not necessarily met. Costs <£10k	Negligible Costs <£10k
C2	Minor (single minor injury)	Minor Minor damage Costs £10k – £100k	Minor Tier 1 – Tier 2 criteria reached. Small operational (oil) spill with little effect on environmental amenity Costs £10K–£100k	Minor Bad local publicity and/or short-term loss of revenue Costs £10k – £100k
C3	Moderate Multiple minor or single major injury	Moderate Moderate damage Costs £100k - £1M	Moderate Tier 2 spill criteria reached but capable of being limited to immediate area within site Costs £100k -£1M	Moderate Bad widespread publicity Temporary suspension of operations or prolonged restrictions to project Costs £100k - £1M

Cat.	People	Property	Environment	Business
C4	Major Multiple major injuries or single fatality	Major Major damage Costs £1M -£10M	Major Tier 3 criteria reached with pollution requiring national support. Chemical spillage or small gas release Costs £1M - £10M	Major National publicity, Temporary closure or prolonged restrictions on project operations Costs £1M -£10M
C5	Catastrophic Multiple fatalities	Catastrophic Catastrophic damage Costs >£10M	Catastrophic Tier 3 oil spill criteria reached. International support required. Widespread shoreline contamination. Serious chemical or gas release. Significant threat to environmental amenity. Costs >£10M	Catastrophic International media publicity. Project site closes. Operations and revenue seriously disrupted for more than two days. Ensuing loss of revenue. Costs >£10M

Hazard Data Review Process

Frequency and consequence data was assessed for each hazard drawing initially on the knowledge and expertise of the Marico Marine specialists. This was subsequently influenced by the views and experience of the many stakeholders, whose contribution was greatly appreciated, as well as historic incident where available. It should be noted that the hazards were scored on the basis of the “status quo” i.e. with all existing mitigation measures taken into consideration. The outcome of this process was then checked for consistency against the assessments made in previous and similar risk assessments.

Having decided in respect of each hazard which frequency and consequence criteria are appropriate for the four consequence categories in both the “most likely” and “worst credible” scenarios, eight risk scores were obtained using the following matrix.

TABLE 0-5: RISK FACTOR MATRIX USED FOR HAZARD ASSESSMENT.

Consequence	Cat 5	5	6	7	8	10
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	Cat 4	4	5	6	7	9
	Cat 3	3	3	4	6	8
	Cat 2	1	2	2	3	6
	Cat 1	0	0	0	0	0
	Frequency	>1,000 years	100-1,000 years	10-100 years	1 to 10 years	Yearly

Where:

Risk Number	Risk
0 to 1.9	Negligible
2 to 3.9	Low Risk
4 to 6.9	As Low as Reasonably Practical
7 to 8.9	Significant Risk
9 to 10.0	High Risk

It should be noted that occasionally, a “most likely” scenario will generate a higher risk score than the equivalent “worst credible” scenario; this is due to the increased frequency often associated with a “most likely” event. For example, in the case of a large number of small contact events, the total damage might be of greater significance than a single heavy contact at a much lesser frequency.

Hazard Ranking

The risk scores obtained from the above process were then be analysed further to obtain four indices for each hazard as follows:

1. The average risk score of the four categories in the “most likely” set;
2. The average risk score of the four categories in the “worst credible” set;

3. The maximum risk score of the four categories in the “most likely” set; and
4. The maximum risk score of the four categories in the “worst credible” set.

These scores were then be combined in Marico Marine’s hazard management software “HAZMAN” to produce a single numeric value representing each of the four indices. The hazard list was then sorted in order of the aggregate of the four indices to produce a “Ranked Hazard List” with the highest risk hazards prioritised at the top.

Mitigation

Mitigation measures that could be employed to reduce the likelihood or consequence of the hazards occurring were then identified. Risk controls were reviewed and discussed, and recommendations made as to which would be suitable for the project. Risk controls were proposed that show the greatest reduction in risk to the highest scoring identified hazards and following feedback from consultees.

In addition, the assessment considered the cumulative and in-combination effects of the other developments located near to the project site, such as Holyhead Deep.

ANNEX B – HAZARD LOG – CONSTRUCTION PHASE

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
1	Contact Commercial Ship with Surface Device	A commercial vessel such as a cargo vessel or tanker contacts the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible	No Injury / Possible very minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations.	Multiple minor or single major injury; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	2	1	2	2	3	4	3	4	1	2.58	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
2	Contact Passenger Vessels with Surface Device	A ferry / cruise ship contacts the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	Multiple minor or single major injury; Major damage to vessel; Small operational spill with little effect on the environment - Tier 1 to Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	2	1	2	3	3	4	2	4	2	3.06	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >20m to be deployed within Zones 1,2 and 8; Redesign Northern Boundary; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
3	Contact Fishing Vessel with Surface Device	A fishing vessel contacts with the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	1	4	4	3	1	3	3	3.72	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
4	Contact Recreational Vessel with Surface Device	A recreational vessel contacts with the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	5	4	3	1	2	4	5.13	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
5	Contact Other Vessels with Surface Device	Small vessel (including maintenance Vessel) contacts the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; running for shelter in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	1	5	4	4	1	3	4	5.37	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
6	Contact Commercial Ship with Mid-Water Device (<8m below CD)	A commercial vessel such as a cargo vessel or tanker contacts the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple minor or single major injury; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	3	1	3	2	3	4	3	4	1	3.20	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
7	Contact Passenger Vessels with Mid-Water Device (<8m below CD)	A ferry contacts the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple minor or single major injury; Major damage to vessel; Small operational spill with little effect on the environment - Tier 1 to Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	3	1	3	4	3	4	2	4	3	4.87	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >20m to be deployed within Zones 1,2 and 8; Redesign Northern Boundary; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
8	Contact Fishing Vessel with Mid-Water Device <8m below CD)	A fishing vessel contacts with the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	2	5	4	3	1	3	4	5.65	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
9	Contact Recreational Vessel with Mid-Water Device (<8m below CD)	A recreational vessel contacts with the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	1	5	4	3	1	3	4	6.04	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
10	Contact Other Vessels with Mid-Water Device (<8m below CD)	Maintenance Vessel contacts with the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	2	5	4	4	1	3	4	5.74	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
11	Contact Commercial Ship with Mid-Water Device (>8m below CD)	A commercial vessel such as a cargo vessel or tanker contacts the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple minor or single major injury; Major damage to vessel; Small operational spill with little effect on the environment - Tier 1 to Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	3	1	3	1	3	4	2	4	1	2.88	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
12	Contact Passenger Vessels with Mid-Water Device (>8m below CD)	A ferry / cruise ship contacts the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple minor or single major injury; Major damage to vessel; Small operational spill with little effect on the environment - Tier 1 to Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	3	1	3	3	3	4	2	4	2	3.82	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >20m to be deployed within Zones 1,2 and 8; Redesign Northern Boundary; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
13	Contact Fishing Vessel with Mid-Water Device (>8m below CD)	A fishing vessel contacts the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A

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						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
14	Contact Recreational Vessel with Mid-Water Device (>8m below CD)	A recreational vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
15	Contact Other Vessels with Mid-Water Device (>8m below CD)	Maintenance Vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
16	Contact Commercial Ship with Sea-Bed Device >20m UKC	A commercial vessel such as a cargo vessel or tanker contacts the device	N/A	N/A	N/A	1	1	1	1	1	1	1	1	1	1	0.00	N/A
17	Contact Passenger Vessels with Sea-Bed Device >20m UKC	A ferry contacts the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
18	Contact Fishing Vessel with Sea-Bed Device >20m UKC	A fishing vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
19	Contact Recreational Vessel with Sea-Bed Device >20m UKC	A recreational vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
20	Contact Other Vessels with Sea-Bed Device >20m UKC	Maintenance Vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A

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						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
21	Collision Commercial Ship ICW Commercial Ship	Two commercial vessels collide due to the presence of the devices.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	2	1	4	4	3	3	1	2.54	Continuous Monitoring by Marine Co-ordination Centre; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
22	Collision Commercial Ship ICW Passenger Vessels	A commercial vessel collides with a passenger vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple fatalities; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	3	2	1	3	1	5	4	3	4	1	3.45	Continuous Monitoring by Marine Co-ordination Centre; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
23	Collision Commercial Ship ICW Fishing Vessel	A commercial vessel collides with a fishing vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	2	2	1	2	1	4	4	1	2	1	2.27	Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
24	Collision Commercial Ship ICW Recreational Vessel	A commercial vessel collides with a recreational vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	2	1	4	3	1	3	1	2.72	Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

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						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
25	Collision Commercial Ship ICW Other Vessel	A commercial vessel collides with an other vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	2	2	1	2	2	4	4	1	2	1	2.43	Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
26	Collision Passenger Vessels ICW Passenger Vessel	A passenger vessel collides with a passenger vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Major impact upon operations / temporary closure or prolonged restrictions on project operations.	Multiple fatalities; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	3	3	2	4	2	5	4	3	4	1	4.35	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
27	Collision Passenger Vessels ICW Fishing Vessel	A passenger vessel collides with a fishing vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	2	2	1	2	2	4	4	1	2	1	2.43	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
28	Collision Passenger Vessels ICW Recreational Vessel	A passenger vessel collides with a recreational vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	2	2	4	3	1	3	1	2.96	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys; Appropriate spacing of devices. Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
29	Collision Passenger Vessels ICW Other Vessels	A passenger vessel collides with an other vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	2	2	1	2	3	4	4	1	2	2	3.00	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys; Appropriate spacing of devices. Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
30	Collision Fishing Vessel ICW Fishing Vessel	A fishing vessel collides with a fishing vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	3	4	3	1	2	2	2.76	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
31	Collision Fishing Vessel ICW Recreational Vessel	A fishing vessel collides with a recreational vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	1	3	4	3	1	3	3	3.94	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
32	Collision Fishing Vessel ICW Other Vessels	A fishing vessel collides with an other vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	4	4	3	1	2	3	3.59	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
33	Collision Recreational Vessel ICW Recreational Vessel	A recreational vessel collides with a recreational vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	2	4	4	3	1	3	3	4.69	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
34	Collision Recreational Vessel ICW Other Vessel	A recreational vessel collides with an other vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	1	4	4	3	1	3	3	4.47	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
35	Collision Other Vessels ICW Other Vessels	An other vessel collides with an other vessel due to the presence of the devices.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel;	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	5	4	3	1	2	4	5.13	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
36	Grounding Commercial Ship	A commercial vessel grounds due to the presence of the devices and their moorings.	N/A	N/A	N/A	1	1	1	1	1	1	1	1	1	1	0.00	NOT SCORED
37	Grounding Passenger Vessels	A passenger vessel grounds due to the presence of the devices and their moorings.	N/A	N/A	N/A	1	1	1	1	1	1	1	1	1	1	0.00	NOT SCORED

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
38	Grounding Fishing Vessel	A fishing vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Minor impact upon operations / short term loss of revenue.	2	2	1	1	3	4	3	2	2	4	4.03	Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Appropriate spacing of devices. Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
39	Grounding Recreational Vessel	A recreational vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	Multiple fatalities; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Major impact upon operations / temporary closure or prolonged restrictions on project operations.	3	2	1	2	5	5	3	2	4	4	7.01	Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Appropriate spacing of devices. Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
40	Grounding Other Vessel	An other vessel / contacts seabed, rocks or cliff grounds due to the presence of the devices and their moorings.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Grounding during inshore cable laying.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Minor impact upon operations / short term loss of revenue.	2	2	1	1	5	4	3	2	2	4	5.34	Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Appropriate spacing of devices. Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
41	Snagging/ Obstruction Commercial Ship	A commercial vessel's anchor interacts with a cable or the device and its moorings.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Temporary closure or prolonged restrictions on project operations.	1	1	1	2	2	1	1	1	4	1	1.85	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
42	Snagging/ Obstruction Passenger Vessels	A ferry's anchor interacts with a device, its moorings or a cable.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Temporary closure or prolonged restrictions on project operations.	1	1	1	2	2	1	1	1	4	2	2.09	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
43	Snagging/ Obstruction Fishing Vessel	A fishing vessel's gear/ anchor interacts with a cable or the device and its moorings.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Temporary closure or prolonged restrictions on project operations.	2	2	1	1	5	3	2	1	4	4	5.13	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Enhanced Cable Protection; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
44	Snagging/ Obstruction Recreational Vessel	A recreational vessel's gear/ anchor interacts with a cable or the device and its moorings.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	1	1	1	1	2	2	1	1	2	1	0.56	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Enhanced Cable Protection; Establish No Anchoring Areas; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
45	Snagging/ Obstruction Other Vessel	An other vessel's gear/anchor interacts with a cable or the device and its moorings.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure; Lack of knowledge of construction progress / device locations; Partially constructed device not visible.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	4	3	2	1	4	3	3.59	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Enhanced Cable Protection; Establish No Anchoring Areas; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.
46	Breakout of device / device not at stated depth	The device's moorings fail, device becomes a hazard to navigation.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Breaks adrift during deployment operations.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	1	5	4	4	1	3	3	4.72	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Redesign eastern boundary; Check Device Surveys; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House.

ANNEX C – HAZARD LOG OPERATIONAL PHASE

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
1	Contact Commercial Ship with Surface Device	A commercial vessel such as a cargo vessel or tanker contacts the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter in poor weather;	No Injury / Possible very minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations.	Multiple minor or single major injury; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	2	1	2	2	3	4	3	4	1	2.58	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys.
2	Contact Passenger Vessels with Surface Device	A ferry / cruise ship contacts the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; running for shelter in poor weather	No Injury / Possible very minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	Multiple minor or single major injury; Major damage to vessel; Small operational spill with little effect on the environment - Tier 1 to Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	2	1	2	3	3	4	2	4	2	3.06	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >20m to be deployed within Zones 1,2 and 8; Redesign Northern Boundary; Check Device Surveys;
3	Contact Fishing Vessel with Surface Device	A fishing vessel contacts with the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter in poor weather;	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	1	4	4	3	1	3	3	3.72	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
4	Contact Recreational Vessel with Surface Device	A recreational vessel contacts with the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; running for shelter in poor weather	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	5	4	3	1	2	4	5.13	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices.
5	Contact Other Vessels with Surface Device	Small vessel (including maintenance Vessel) contacts with the device	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; running for shelter in poor weather	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	1	4	4	4	1	3	3	3.81	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices.
6	Contact Commercial Ship with Mid-Water Device (<8m below CD)	A commercial vessel such as a cargo vessel or tanker contacts the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; running for shelter.	No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple minor or single major injury; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	3	1	3	2	3	4	3	4	1	3.20	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
7	Contact Passenger Vessels with Mid-Water Device (<8m below CD)	A ferry contacts the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; running for shelter.	No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple minor or single major injury; Major damage to vessel; Small operational spill with little effect on the environment - Tier 1 to Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	3	1	3	4	3	4	2	4	3	4.87	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >20m to be deployed within Zones 1,2 and 8; Redesign Northern Boundary; Check Device Surveys.
8	Contact Fishing Vessel with Mid-Water Device <8m below CD)	A fishing vessel contacts with the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	2	5	4	3	1	3	4	5.65	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices.
9	Contact Recreational Vessel with Mid-Water Device (<8m below CD)	A recreational vessel contacts with the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	1	5	4	3	1	3	4	6.04	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
10	Contact Other Vessels with Mid-Water Device (<8m below CD)	Maintenance Vessel contacts with the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	2	5	4	4	1	3	4	5.74	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate spacing of devices.
11	Contact Commercial Ship with Mid-Water Device (>8m below CD)	A commercial vessel such as a cargo vessel or tanker contacts the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth.	No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple minor or single major injury; Major damage to vessel; Small operational spill with little effect on the environment - Tier 1 to Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	3	1	3	1	3	4	2	4	1	2.88	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys.
12	Contact Passenger Vessels with Mid-Water Device (>8m below CD)	A ferry / cruise ship contacts the device	Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter; Device not at stated depth.	No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple minor or single major injury; Major damage to vessel; Small operational spill with little effect on the environment - Tier 1 to Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	1	3	1	3	3	3	4	2	4	2	3.82	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >20m to be deployed within Zones 1,2 and 8; Redesign Northern Boundary; Check Device Surveys.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
13	Contact Fishing Vessel with Mid-Water Device (>8m below CD)	A fishing vessel contacts the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
14	Contact Recreational Vessel with Mid-Water Device (>8m below CD)	A recreational vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
15	Contact Other Vessels with Mid-Water Device (>8m below CD)	Maintenance Vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
16	Contact Commercial Ship with Sea-Bed Device >20m UKC	A commercial vessel such as a cargo vessel or tanker contacts the device	N/A	N/A	N/A	1	1	1	1	1	1	1	1	1	1	0.00	N/A
17	Contact Passenger Vessels with Sea-Bed Device >20m UKC	A ferry contacts the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
18	Contact Fishing Vessel with Sea-Bed Device >20m UKC	A fishing vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
19	Contact Recreational Vessel with Sea-Bed Device >20m UKC	A recreational vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
20	Contact Other Vessels with Sea-Bed Device >20m UKC	Maintenance Vessel contacts with the device	N/A	N/A	N/A	1	1	1	1	0	1	1	1	1	0	0.00	N/A
21	Collision Commercial Ship ICW Commercial Ship	Two commercial vessels collide due to the presence of the devices.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel;	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	2	1	4	4	3	3	1	2.54	Continuous Monitoring by Marine Co-ordination Centre.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
22	Collision Commercial Ship ICW Passenger Vessels	A commercial vessel collides with a passenger vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	Multiple fatalities; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	3	2	1	3	1	5	4	3	4	1	3.45	Continuous Monitoring by Marine Co-ordination Centre.
23	Collision Commercial Ship ICW Fishing Vessel	A commercial vessel collides with a fishing vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	2	2	1	2	1	4	4	1	2	1	2.27	Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys.
24	Collision Commercial Ship ICW Recreational Vessel	A commercial vessel collides with a recreational vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	2	1	4	3	1	3	1	2.72	Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys.
25	Collision Commercial Ship ICW Other Vessel	A commercial vessel collides with an other vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	2	2	1	2	1	4	4	1	2	1	2.27	Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
26	Collision Passenger Vessels ICW Passenger Vessel	A passenger vessel collides with a passenger vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Major impact upon operations / temporary closure or prolonged restrictions on project operations.	Multiple fatalities; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations.	3	3	2	4	1	5	4	3	4	1	4.00	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys.
27	Collision Passenger Vessels ICW Fishing Vessel	A passenger vessel collides with a fishing vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	2	2	1	2	2	4	4	1	2	1	2.43	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys.
28	Collision Passenger Vessels ICW Recreational Vessel	A passenger vessel collides with a recreational vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	2	2	4	3	1	3	1	2.96	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys; Appropriate spacing of devices.
29	Collision Passenger Vessels ICW Other Vessels	A passenger vessel collides with an other vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue.	2	2	1	2	2	4	4	1	2	1	2.43	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys; Appropriate spacing of devices.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
30	Collision Fishing Vessel ICW Fishing Vessel	A fishing vessel collides with a fishing vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	3	4	3	1	2	2	2.76	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices.
31	Collision Fishing Vessel ICW Recreational Vessel	A fishing vessel collides with a recreational vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	1	3	4	3	1	3	3	3.94	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices.
32	Collision Fishing Vessel ICW Other Vessels	A fishing vessel collides with an other vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	3	4	3	1	2	2	2.76	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices.
33	Collision Recreational Vessel ICW Recreational Vessel	A recreational vessel collides with a recreational vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	2	4	4	3	1	3	3	4.69	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
34	Collision Recreational Vessel ICW Other Vessel	A recreational vessel collides with an other vessel due to the presence of the devices	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	3	2	1	1	3	4	3	1	3	3	3.94	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices.
35	Collision Other Vessels ICW Other Vessels	An other vessel collides with an other vessel due to the presence of the devices.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	3	4	3	1	2	2	2.76	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices.
36	Grounding Commercial Ship	A commercial vessel grounds due to the presence of the devices and their moorings.		N/A	N/A	1	1	1	1	1	1	1	1	1	1	0.00	NOT SCORED
37	Grounding Passenger Vessels	A passenger vessel grounds due to the presence of the devices and their moorings.		N/A	N/A	1	1	1	1	1	1	1	1	1	1	0.00	NOT SCORED
38	Grounding Fishing Vessel	A fishing vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Minor impact upon operations / short term loss of revenue.	2	2	1	1	4	4	3	2	2	3	3.74	Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Appropriate spacing of devices.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
39	Grounding Recreational Vessel	A recreational vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	Multiple fatalities; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Major impact upon operations / temporary closure or prolonged restrictions on project operations.	3	2	1	2	5	5	3	2	4	4	7.01	Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Appropriate spacing of devices.
40	Grounding Other Vessel	An other vessel / contacts seabed, rocks or cliff grounds due to the presence of the devices and their moorings.	Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Minor impact upon operations / short term loss of revenue.	2	2	1	1	4	4	3	2	2	3	3.74	Continuous Monitoring by Marine Co-ordination Centre; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Appropriate spacing of devices.
41	Snagging/ Obstruction Commercial Ship	A commercial vessel's anchor interacts with a cable or the device and its moorings.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Temporary closure or prolonged restrictions on project operations.	1	1	1	2	2	1	1	1	4	1	1.85	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys.
42	Snagging/ Obstruction Passenger Vessels	A ferry's anchor interacts with a device, its moorings or a cable.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Temporary closure or prolonged restrictions on project operations.	1	1	1	2	2	1	1	1	4	2	2.09	Continuous Monitoring by Marine Co-ordination Centre; Devices >20m below CD to be deployed along northern boundary; Redesign northern boundary; Check Device Surveys.

ID	Hazard Title	Hazard Detail	Possible Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely Consequence				Frequency	Worst Credible Consequence				Frequency	Risk Score	Possible Additional Risk Controls
						People	Property	Environment	Stakeholders		People	Property	Environment	Stakeholders			
43	Snagging/ Obstruction Fishing Vessel	A fishing vessel's gear/ anchor interacts with a cable or the device and its moorings.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Temporary closure or prolonged restrictions on project operations.	2	2	1	1	5	3	2	1	4	4	5.13	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co- ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Enhanced Cable Protection.
44	Snagging/ Obstruction Recreational Vessel	A recreational vessel's gear/ anchor interacts with a cable or the device and its moorings.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	1	1	1	1	2	2	1	1	2	1	0.56	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co- ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Enhanced Cable Protection; Establish No Anchoring Areas.
45	Snagging/ Obstruction Other Vessel	An other vessel's gear/anchor interacts with a cable or the device and its moorings.	Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure.	No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations / short term loss of revenue.	2	2	1	1	2	3	2	1	4	2	2.54	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co- ordination Centre; Exclusion of fishing within Morlais Zone; Devices >8m below CD to be deployed along eastern boundary; Redesign eastern boundary; Check Device Surveys; Appropriate alignment and spacing of devices; Enhanced Cable Protection; Establish No Anchoring Areas.
46	Breakout of device / device not at stated depth	The device's moorings fail, device becomes a hazard to navigation.	Equipment or Mechanical Failure; Adverse Environmental Conditions.	Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations.	Multiple major injuries or a single fatality; Major damage to vessel; Negligible effect upon the Environment / No pollution; Temporary Suspension of operations or prolonged restrictions to project.	2	2	1	1	3	4	4	1	3	2	2.95	Restrict Navigation through Morlais Zone; Continuous Monitoring by Marine Co- ordination Centre; Exclusion of fishing within Morlais Zone; Redesign eastern boundary; Check Device Surveys.

ANNEX D - MINUTES FROM CONSULTATION

Minutes of Meeting held on 19-11-2018 - Welsh Fishing Association

Client: Menter Môn

Project: Morlais Tidal Demonstration Zone

Venue: The Boathouse Hotel, Holyhead, Anglesey

Date of Meeting: 19 November 2018 at 18:00

Welsh Fishing Association (WA) Trevor Jones (TJ)

Marico Marine (MM) David Foster (DF)

Rebecca Worbey (RW)

Menter Môn (MN) Gerallt Llewelyn Jones (GLJ)

ATEB (AT) Rhys Evans (RE)

Item	Action item / Notes for the record	Action
1	Introductions	
	<ul style="list-style-type: none"> Introduction to Marico Marine <ul style="list-style-type: none"> RW explained that MM had been appointed by MN to undertake a Navigation Risk Assessment of the Morlais Tidal Demonstration Project. Introduction of the Morlais Tidal Demonstration project. <ul style="list-style-type: none"> RW explained that the site is in the pre-application phase and has adopted a flexible project envelope approach and as such there is not yet a device specific layout. The device specific layout will be informed by the navigation risk assessment in addition to environmental, social and commercial factors. 	
2	Background – Fishing in Vicinity of Morlais Zone	
	<ul style="list-style-type: none"> Catch types: <ul style="list-style-type: none"> Velvet Crab (within 10m contour) Lobster (within 10m contour) Green Shore Crab (within 10m contour) Whelks, neap tide, using a number of baited pots on long lines Scallops (Slack water, Beam trawlers) Skate (deeper water) Deeper water fishing methods: <ul style="list-style-type: none"> Fixed netting Danish ring netting Seabed Characteristics: <ul style="list-style-type: none"> Very mobile seabed Sand and fine gravel Whelkers and Potters go into Holyhead. 	

	<ul style="list-style-type: none"> • Very little pelagic fishing in area, huge runs of fish, almost as good as Scotland, however, no quota to fish it. • Longlining has decreased in recent years. Occurs within all sub-zones. • Few that partake in rec. netting, which occurs mainly in top 1 to 5 sub-zones and subzone 8. 	
3	Fishing Vessel Traffic Analysis (comments on plot)	
	<ul style="list-style-type: none"> • TJ -Fishing vessel traffic on plot appears to be light. There is a plethora of under 10s that operate within the area. • TJ – Abrahams Bosom should be more populated. Pot buoys – head ropes inshore within 10m contour. • July is a very active month and therefore, there should be more traffic than demonstrated on the plot. There is very little traffic at the end of February / start of March. • The Morlais Zone is not very fishing friendly due to the tidal conditions, except for at slack water. 	
4	Impacts	
	<ul style="list-style-type: none"> • TJ – If the project were to go ahead fishing in the area would be sterilised due to snagging and gear loss issues – may get some fishermen attempting to set pots as lobsters will hide within devices which will create a new habitat. • Vessels will not be able to anchor in the zone if they run into difficulties. • At maximum capacity, a fishing boat would not attempt to navigate through the zones, even if they were lit. • TJ commented that a friend who is a scalloper will not fish within wind farm with 2 knots of tide as the risk of gear loss is too high. TJ – considers that the tidal site as a much greater hazard than a wind farm as you cannot clearly see between the devices. • There is a risk of loss of power and drifting in to the devices • TJ – It appears that vessels will have to navigate around the outside of the Zone. 	
5	Inshore Passage	
	<ul style="list-style-type: none"> • Inshore passage is a manageable gap, however, the current makes it difficult to navigate. • The inshore passage would not be navigable for a coaster. • Collision risk will likely increase, however, TJ does not consider increase will be appreciable. However, may be of concern for yachts/powerboats in summer. • Normal passage planning would allow 1-2 miles offing from a steep to danger. 	
6	Under Keel Clearance (UKC)	
	<ul style="list-style-type: none"> • Required UKC should allow for worst case wave height and vessel draught. 	

	<ul style="list-style-type: none"> TJ – 8m minimum UKC required for fishing vessels to navigate over devices. The separation between / spread of devices will be of highest concern. Deep water devices should be monitored to ensure they are at the stated depth. 	
7	Marking and Lighting	
	<ul style="list-style-type: none"> To navigate through windfarms a skipper requires parallel index lines on the radar to navigate safely through the devices. This would be more difficult with tidal devices. TJ - Cardinal mark the whole zone. 	
8	Anchoring	
	<ul style="list-style-type: none"> Abraham's Bosom is not a very good holding ground, no one anchors here if they can help it. Very quickly you are in 30m plus water depths. 	
9	Running for Shelter	
	<ul style="list-style-type: none"> One of the rights of navigation is that you should be able to run to a safe haven if you get caught. Holyhead is the only close safe-haven. If this option were to be lost, then vessels would be very stuck. 	
10	Risk Controls	
	<ul style="list-style-type: none"> TJ - Engagement with stakeholders is key. Stakeholders must be informed the whole way along 	
11	Other	
	<ul style="list-style-type: none"> TJ suggested MM look up the Welsh government Fisheries Marine Planning portal and the Association of IFCA. Arklow Marine are very active in the Irish Sea – Offshore O&M services 	

Minutes of Meeting held on 20-11-2018 – Harbour Master

Client: Menter Môn
 Project: Morlais Tidal Demonstration Zone
 Venue: The Harbour Master's Office, Holyhead, Anglesey
 Date of Meeting: 20 November 2018 at 10:00

Harbour Master	Kevin Riley (KR)
Port Manager	Wynn Parry (WP)
Marico Marine (MM)	David Foster (DF)
	Rebecca Worbey (RW)
Menter Môn (MN)	Graham Morley (GM)

Item	Action item / Notes for the record	Action
1	Introductions	
	<p>Introduction to Marico Marine</p> <ul style="list-style-type: none"> RW explained that MM had been appointed by MN to undertake a Navigation Risk Assessment of the Morlais Tidal Demonstration Project. <p>Introduction of the Morlais Tidal Demonstration project.</p> <ul style="list-style-type: none"> RW explained that the site is in the pre-application phase and has adopted a flexible project envelope approach and as such there is not yet a device specific layout. The device specific layout will be informed by the navigation risk assessment in addition to environmental, social and commercial factors. <p>At the outset KR and WP expressed their main concern with the proposed project is any potential adverse effect on the Dublin to Holyhead ferry services.</p>	
2	Holyhead Operations and Port Development	
	<p>KR and WP outlined the current port operations including:</p> <ul style="list-style-type: none"> Holyhead Harbour Port Control provides Local Port Service (LPS); Stena and Irish ferry services; Cruise ship visits; Bunker barge and product tanker visits; General cargo operations; Fishing vessel activity; Tug and off-shore support vessel activity; and Recreation (including the damage to the Holyhead Marina in Q1/18). <p>Port Development Plan:</p> <ul style="list-style-type: none"> Berth extension to enable the handling of more general cargo and larger cruise ships; Construction of a berth nearby to be used in the construction of a nuclear power plant; 	

	<ul style="list-style-type: none"> • The Port Development Plan is planned to be submitted in Q1/19. • Once the new infrastructure has been constructed KR and WP expect the overall port traffic to increase. 	
3	Ferry Draught and Under Keel Clearance	
	<ul style="list-style-type: none"> • KR stated that Holyhead Harbour maintain a charted depth >10m in those areas used for ferry manoeuvring and operations. • KR considered that the current Stena and Irish Ferries' vessels require approximately 20m to safely navigate at all states of the tide and in all weather conditions. • KR noted that the seas in the vicinity of the Holyhead Deep can be particularly rough and the area is avoided by the ferries. 	
4	Vessel Traffic Plots	
	<p>RW ran through the vessel traffic plots.</p> <ul style="list-style-type: none"> • KR confirmed that the traffic plots were similar to what he would have anticipated other than the fishing vessel activity shown in the inshore area was less than he would have expected. • KR assumed the majority of the survey vessel tracks were associated with the survey vessel attached to Bangor University (MV Prince Madog tbc) 	
5	Inshore Passage	
	<p>KR made the following comments:</p> <ul style="list-style-type: none"> • The proposed inshore route (between the eastern side of the zone and the coast of Holy Island) was unlikely to be used by coasters/short sea shipping vessels. • Considered that the width of the inshore passage between Holy Island and the zone is too narrow for small vessel navigation except during clement weather conditions. 	
6	Anchoring	
	<ul style="list-style-type: none"> • KR was unaware of commercial vessels anchoring in Abrahams Bosom. 	
7	Other comments	
	<ul style="list-style-type: none"> • KR suggested an additional hazard to be considered of a vessel losing power and then being swept/blown down on to the devices. 	

Minutes of Meeting held on 20-11-2018 – Stena Line

Client: Menter Môn
 Project: Morlais Tidal Demonstration Zone
 Venue: Stena Adventurer
 Date of Meeting: 20 November 2018 at 12:00

Stena Line (SL) Captain John Hambley-Jones (JHJ)
 Marico Marine (MM) David Foster (DF)
 Rebecca Worbey (RW)
 Menter Môn (MN) Graham Morley (GM)

Item	Action item / Notes for the record	Action
1	Introductions	
	<p>Introduction to Marico Marine</p> <ul style="list-style-type: none"> RW explained that MM had been appointed by MN to undertake a Navigation Risk Assessment of the Morlais Tidal Demonstration Project. <p>Introduction of the Morlais Tidal Demonstration project.</p> <ul style="list-style-type: none"> RW explained that the site is in the pre-application phase and has adopted a flexible project envelope approach and as such there is not yet a device specific layout. The device specific layout will be informed by the navigation risk assessment in addition to environmental, social and commercial factors. 	
2	Background – Stena Operations	
	<p>270° to 090° is normal Dublin to Holyhead line.</p> <p><u>Alternative Weather Routeing</u></p> <ul style="list-style-type: none"> During a SW gale (rare but considered to be the most difficult) 046° line is utilised, which takes the vessel through the site, however, it would be possible to transpose the route further to the north. The prime reason for the alternate route is to reduce rolling resulting in cargo shift, passenger and crew injury and fixed fittings breaking free. Wave heights of >4m are not comfortable. Alternative weather routing plus 100% cargo lashing must be taken with a forecast of >4m waves. Master may alter heading as opposed to position so there is a dynamic aspect to poor weather routeing. Ferries do not transit near to the tidal race. 	
3	Other Vessel Operations	
	<p><u>Cargo Vessels</u></p> <ul style="list-style-type: none"> New 400m berth in Holyhead will be bringing in aggregate. New nuclear power station with associated vessels bringing in materials from the south. No coastal cargo traffic at present. 	

	<u>Fishing Vessels</u> <ul style="list-style-type: none"> • Whelk fisherman are active to the west, close to Minesto. • Fisherman not often witnessed within the proposed Morlais Zone area as this is where the tides meet resulting in rough seas. 	
4	Impacts	
	<ul style="list-style-type: none"> • The presence of surface devices at the northern boundary may impact ferry operations. • Device breakout and stated device depth not being maintained would be of concern. • Visibility of surface devices due to low height above water surface is a concern. 	
5	Inshore Passage	
	<ul style="list-style-type: none"> • Only recreational vessels could utilise this given the available space. • The tide is N/S so vessels utilizing the inshore passage will not be set on by the tide. • Coasters would not use this route. They would use the Traffic Separation Scheme (TSS). Cargo vessels do not need to come inshore anymore for pilots. 	
6	Under Keel Clearance (UKC)	
	<ul style="list-style-type: none"> • Normal draught is 6m. In bad weather pitch is 6m greater = 12m at mean low water springs. Passage planning outside of the 15m contour. A mid-water device at 15m therefore, wouldn't cause issues. 	
7	Mitigation Measures	
	<ul style="list-style-type: none"> • Mark project zone on charts and ensure ECDIS is up to date. • Ensure surface devices are clearly visible – however, if the zone is densely populated with surface devices which are all lit, run the risk of the whole zone being lit. • Consider devices >15m below CD in the northern most sub-zones. 	
8	Other	
	<ul style="list-style-type: none"> • Superfast ferry replaced by super ferry – same UKC criteria applies for both. • JHJ – questioned if Marico had spoken to the MOD. DF – explained that the proposed site is outside of the MOD PEXA. • JHJ – questioned the spacing of the devices? RW – explained that the layout and subsequently spacing of devices has not yet been determined. 	

Minutes of Meeting held on 20-11-2018 - Recreational

Client: Menter Môn

Project: Morlais Tidal Demonstration Zone

Venue: The Boathouse Hotel

Date of Meeting: 20 November 2018 at 18:00

Trearddur Bay Sailing Club (TBSC) Matthew Davis (MD)

Royal Yachting Association (RYA) Mike Butterfield (MB)

Anglesey Water Sport (AW) Davina Carey- Evans(DCE)

Anglesey School of Yachting (AY) David Williams (DW)

Marico Marine (MM) David Foster (DF)

Rebecca Worbey (RW)

Menter Môn (MN) Gwenan Edwards (GE)

ATEB (AT) Rhys Evans (RE)

Item	Action item / Notes for the record	Action
1	Introductions	
	<p>Introduction to Marico Marine</p> <ul style="list-style-type: none"> RW explained that MM had been appointed by MN to undertake a Navigation Risk Assessment of the Morlais Tidal Demonstration Project. <p>Introduction of the Morlais Tidal Demonstration project.</p> <ul style="list-style-type: none"> RW explained that the site is in the pre-application phase and has adopted a flexible project envelope approach and as such there is not yet a device specific layout. The device specific layout will be informed by the navigation risk assessment in addition to environmental, social and commercial factors. <p>Introduction of Navigation Risk</p> <ul style="list-style-type: none"> DF introduced navigation risk and the risk assessment process. 	
2	Existing Traffic Profile	
	<ul style="list-style-type: none"> MD – Recreational traffic under-represented within plot. Last weekend of July to bank holiday weekend of August represents busiest period. The inshore passage is widely used by recreational vessels, particularly areas around Abrahams Bosom, South Stack and North Stack. Vessel traffic pattern represented within analysis looks correct. Trearddur Bay Sailing Club <ul style="list-style-type: none"> has 58 yacht moorings in addition to RHIBs, dinghies and kayaks. 	

	<ul style="list-style-type: none"> ○ Membership is capped at 1,000 • MD- there are many kayakers active in the area that follow the coast-line around Holyhead and utilise the inshore passage. • Racing <ul style="list-style-type: none"> ○ Holyhead Sailing Club participates in racing around Anglesey. They race out of Holyhead harbour and will cross the northern portion of the site. ○ TBSC races around the stacks and can travel around 1km off the South Stack when racing to and from Holyhead. • Tracks transiting SW / NE through site are from Bardsey Island and Cork. Usage of this route is limited in comparison to the inshore route. 	
3	Impacts	
	<ul style="list-style-type: none"> • MB – the proposed zone has the potential to have a long-term impact on the recreational use around the island. • The primary concern is the restriction of the inshore passage which is essential to recreational vessels. • DCE – Concerned about the visual impact surface devices may have on tourism 	
4	Inshore Passage	
	<ul style="list-style-type: none"> • If vessels transit too close to the shore, then there is a risk of wash deflecting off of the shore which is hazardous to small vessels. • DW – at least a 2-mile offing would be required to clear the over-falls. • It is considered that there is an increased risk of collision due to navigating within a reduced area. • MB – questioned whether the increase in survey vessels will increase traffic density in the inshore passage. DF – survey vessels would likely go around the site. 	
5	Under Keel Clearance (UKC)	
	<ul style="list-style-type: none"> • Large racing yachts have a draught of <2.5m. Therefore, in good weather if devices are >3m below CD then most would be able to transit above them. • In poor weather safe UKC will increase to allow for wave heights. In this case a minimum of 6-7m is recommended. • >5m waves are unusual within this area. 	
6	Running for Shelter	
	<ul style="list-style-type: none"> • Holyhead is the only nearby safe-haven for running for shelter. Caernarvon is not accessible during poor weather. • MD – Surface mounted devices would represent a considerable hazard to a yacht making for Holyhead in a gale and it is therefore, the preference of TBSC, not to have surface mounted devices within the project. 	

	<ul style="list-style-type: none"> • MB- recreational vessels would be taking a severe risk attempting to transit through the site at night should it be populated with surface and near surface devices. 	
7	Anchoring	
	<ul style="list-style-type: none"> • Recreational vessels do anchor in Abraham's Bosom, however, it is not an overnight anchor. 	
8	Marking and Lighting	
	<ul style="list-style-type: none"> • MD –if the devices are under water with a sufficient UKC preference would be that there is no buoy at the surface to maintain navigation. Anything at the surface with the potential to break free should be avoided. MB – agreed that buoys are hazardous in themselves and are difficult to maintain. • MB – Swept depth should be given on chart 	
9	Risk Control Measures	
	<ul style="list-style-type: none"> • Use seabed mounted devices only or those >6-7m below CD. This would allow the site to remain accessible for running for shelter purposes. • Locate surface devices away from the eastern boundary allowing >1 mile space for the inshore passage. • If surface devices are spaced adequately then sailing could occur between them, although this would not be recommended at night. • Surface devices to be adequately lit. • Ensure that devices remain at the specified depth and are regularly surveyed and monitored. • Relocate eastern boundary – If it were a mile offshore then there wouldn't be a significant impact to the inshore route. • Communication <ul style="list-style-type: none"> ○ Notify local clubs directly ○ Social media such as Twitter is monitored by a lot of recreational users and is a good route for communication. ○ Notify marinas separately ○ Notice To Mariners (NTM) are not widely read by the recreational community as with commercial vessels and is, therefore, not considered to be an adequate means of communication. ○ DW -Met Office Shipping Forecast includes shipping warnings relayed by VHF by Coastguard – this should include ant maintenance issues, emergency failures and any other relevant matters. 	
10	Other	
	<ul style="list-style-type: none"> • RYA sailing routes may be downloaded from the RYA website. • MD – Small vessels do not formally route plan and rarely carry charts on board. 	

	<ul style="list-style-type: none">• DCE – There is a huge density of wrecks within the zone and divers will be active within the area. 200 wrecks are registered within the Anglesey area, however, there are more.	
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Minutes of Meeting held on 21-11-2018 - RNLI

Client: Menter Môn
 Project: Morlais Tidal Demonstration Zone
 Venue: RNLI Holyhead
 Date of Meeting: 21 November 2018 at 10:00

RNLI	Ian James (IJ)
	Tony Price (TP)
Marico Marine (MM)	David Foster (DF)
	Rebecca Worbey (RW)
Menter Môn (MN)	Graham Morley (GM)

Item	Action item / Notes for the record	Action
1	Introductions	
	<p>Introduction to Marico Marine</p> <ul style="list-style-type: none"> RW explained that MM had been appointed by MN to undertake a Navigation Risk Assessment of the Morlais Tidal Demonstration Project. <p>Introduction of the Morlais Tidal Demonstration project.</p> <ul style="list-style-type: none"> RW explained that the site is in the pre-application phase and has adopted a flexible project envelope approach and as such there is not yet a device specific layout. The device specific layout will be informed by the navigation risk assessment in addition to environmental, social and commercial factors. 	
2	Background – RNLI Operations	
	<ul style="list-style-type: none"> March 31st to October 31st represents the busiest period. Both RNLI vessels – <i>Christopher Pearce</i> (7 class) and <i>Mary and Archie Hooper</i> (D Class) are equipped with AIS. RNLI vessel tracks captured within radar survey/AIS matches expectations. Vessels commonly break down to the south of the proposed zone close to Careg Hen and drift northwards into the proposed project zone. Leisure craft from the Isle of Man in way towards Skerries sometimes break down due to fatigue however, on ebb tide are naturally pushed out to sea. Searches have been undertaken within the project area. For example, a multivessel search ‘line’ approach was undertaken in search of a missing fisherman within the project area. 	
3	Other Vessel Operations	
	<ul style="list-style-type: none"> Fishing occurs close to shore (e.g. potting), however, is limited due to the tide. 	

	<ul style="list-style-type: none"> It was considered that the AIS/Radar plots showed less fishing activity in the area than they would have expected though the other plots appeared representative. Whelkers attempt to fish in the deep -water area however the tidal race makes it difficult except at neap tides. SS Waverley comes close to shore when it visits. If blowing hard from the north, some of the larger vessels shelter at Caernarvon Bay/ behind Anglesey. RNLI do not believe that the Holyhead Yacht Club participate in the Round Anglesey Yacht Race any longer. 	
4	Inshore Route	
	<ul style="list-style-type: none"> TP stated that if he were making a passage through inshore passage he does not believe that there would be sufficient spacing between the devices and the cliffs to navigate safely except in benign conditions. 3-4 cables off South Stack should normally be required with windage around the stack as, if engine was to fail during a westerly, then the vessel would be too close to shore. Fishing vessels would struggle in an inshore passage of this size. 	
5	Under Keel Clearance (UKC)	
	<ul style="list-style-type: none"> Vessels draw 2m, 6-7m in bad weather (assuming worst case wave height). RNLI vessel has bottomed out at 5m during neap tide. Even at 12m HOT above Chart Datum (CD) the larger RNLI vessel hit the bottom in high sea state. RNLI considers 6-8m under keel clearance is necessary for small vessels (<2.5m draught) to navigate safely over submerged devices in all states of tide and weather conditions. 	
6	Marking / Lighting / Charting	
	<ul style="list-style-type: none"> Larger commercial vessels utilizing TSS should be very aware of Notice To Mariners (NTM) and Areas to Be Avoided (ATBA). The issue is smaller recreational vessels. 	
7	Running for Shelter	
	<ul style="list-style-type: none"> South Stack is the beacon used as a waypoint for vessels coming in (vessels from Ireland etc.). Vessels from south – west Ireland will definitely transit through the zone when running for shelter. Vessels will no longer be able to do this if the area is fully populated with surface devices and instead will have to go around the site. In which case it should be properly marked. 	
8	Risk Controls	
	<ul style="list-style-type: none"> No buoys on the mid-water devices to allow navigation to continue. RNLI questioned what the spacing of the devices will be. GM explained there will be 200m between surface devices. RNLI believe having them close may be a good thing as they will be clearly visible and vessels are not left wondering where the other devices are and it will encourage 	

	<p>vessels to go around the entire site rather than attempting to get through.</p> <ul style="list-style-type: none"> • Radar reflectors / RACONS on all four corners. • Consider AIS on all four corners. 	
9	Other	
	<ul style="list-style-type: none"> • The RNLI has already responded to an incident involving a recreational vessel colliding with a Minesto Buoy. The radar reflector on the buoy was lost and the mast of the yacht broke. • The RNLI questioned if there will be a disturbance to the surface of the water as a result of the submerged devices. GM – the surface will not be impacted. 	

Minutes of Meeting held on 21-11-2018 – Irish Ferries

Client: Menter Môn
 Project: Morlais Tidal Demonstration Zone
 Venue: Ulysses
 Date of Meeting: 21 November 2018 at 11:30

Irish Ferries (IF)	Girts Fisers-Blumbergs (GFB)
	Paul Woodbury (PW)
Marico Marine (MM)	David Foster (DF)
	Rebecca Worbey (RW)
Menter Môn (MN)	Graham Morley (GM)

Item	Action item / Notes for the record	Action
1	Introductions	
	<p>Introduction to Marico Marine</p> <ul style="list-style-type: none"> DF explained that MM had been appointed by Menter Mon to undertake a Navigation Risk Assessment of the Morlais Tidal Demonstration Project. <p>Introduction of the Morlais Tidal Demonstration project.</p> <ul style="list-style-type: none"> RW explained that the site is in the pre-application phase and has adopted a flexible project envelope approach and as such there is not yet a device specific layout. The device specific layout will be informed by the navigation risk assessment in addition to environmental, social and commercial factors. GFB – questioned when the project install is to occur? GM – installation is planned for 2021 to 2022. <p>Review of preliminary vessel traffic analysis</p> <ul style="list-style-type: none"> PW questioned why there are no examples of the poor weather route in the passenger vessel track plot. RW explained that in the 2 weeks of winter data that was analysed, the poor weather route was not utilised however 6 months of additional winter AIS data has been purchased for analysis within the NRA that will include an example of this. 	
2	Background – Irish Ferries Operations	
	<ul style="list-style-type: none"> Two large ferries (<i>Ulysses</i> and <i>Epsilon</i>) and one lighter fast ferry in operation (<i>Dublin Swift</i> catamaran). The ferries will not normally operate in 5m waves. Irish Ferries has a 2.5m sea state limit. (Passenger certificate says 4m sea state limit, however, Irish Ferries company limit is 2.5m). Target is to pass 1.5 miles north of south stack – normal route is the most direct path. 7° Poor weather route is utilised in SW gales and when sea state is building up to 3.5m significant waves. This is to put the sea further 	

	<p>astern to reduce rolling and to avoid lashing and ensure the safety of cargo.</p> <ul style="list-style-type: none"> • Holyhead Deep is considered to be an Area To Be Avoided (ATBA) during high seas as this is the main area of wave build up. • Irish Ferries avoid navigating too close to shore due to wave build up. Irish Ferries never transit closer than half a mile to shore. • During SSE gales, Irish Ferries utilise the northern route. • North westerlys do not build-up like south westerlys. • Usage of the alternative poor weather routes varies. For example: it was utilised for approximately 3 weeks in 2017 (mainly within November) and 3 days so far in 2018. • Waiting area to the south of the Morlais Zones rarely utilised (2 times in 13 years by the <i>Ulysses</i>. Similar usage by <i>Epsilon</i>. 	
3	Other Vessel Operations	
	<ul style="list-style-type: none"> • In bad weather smaller cargo vessels will pass inside the TSS. 	
4	Impacts	
	<ul style="list-style-type: none"> • The northern most two sub-zones and the top of the western sub-zone would clip the SW poor weather route. • Normal weather route would be restricted. Adequate space must be left to allow Irish Ferries and Stena to cross. • The route south to the “waiting area” passes directly through the Morlais Zones. 	
5	Under Keel Clearance (UKC)	
	<ul style="list-style-type: none"> • An adequate UKC to allow continued navigation would be 2 x draughts below the keel (total 3 draughts). This would result in a 20m minimum clearance as with Minesto. 	
6	Suggested Mitigation Measures	
	<ul style="list-style-type: none"> • GFB - Irish Ferries could transit along the eastern boundary of Holyhead Deep around the edge of the Morlais project when heading to waiting area to the south. • Devices with >20m clearance only in northern most zones. • Consideration should be given to virtual buoys – they do not require a physical object to be present within the water, however, are detectable by vessel’s AIS. • If surface devices were to be deployed then the northern most zone boundary should be clearly marked. • Ensure that for all seabed devices that all supporting equipment (eg: cables and hubs) are on the seabed to maintain navigability. 	
7	Other Comments	
	<ul style="list-style-type: none"> • GFB – believes that the impact of the project to ferries will be less than to other vessel types such as recreational vessels. 	

	<ul style="list-style-type: none"> • The presence of the Morlais Project will prevent vessels approaching the ferry route from the south. • GFB – noted that in terms of diversions - a Traffic Separation Scheme (TSS) may be implemented in a day and would likely cause much greater diversions than those that would result from the Morlais Project. 	
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Minutes of Meeting held on 10 December-2018 - RYA

Client: Menter Môn
 Project: Morlais Tidal Demonstration Zone
 Venue: RYA, Ensign Way, Hamble-le-Rice, Southampton SO31 4YA
 Date of Meeting: 10 December 2018 at 12:00

Royal Yachting Stuart Carruthers (SC)
 Association (RYA)
 Marico Marine (MM) David Foster (DF)
 Rebecca Worbey (RW)

Item	Action item / Notes for the record	Action
1	Introductions	
	<ul style="list-style-type: none"> RW explained that MM has been appointed by Menter Môn to undertake a Navigation Risk Assessment of the Morlais Tidal Demonstration Project. RW introduced the Morlais Tidal Demonstration Project. DF explained that local consultation including meeting with recreational stakeholders had taken place. SC explained that the RYA was consulted on the project by Menter Môn 2 years ago. SC explained that the RYA clearly communicated its issues with the inshore route and Menter Môn agreed to review the eastern boundary following the meeting, however, the RYA did not hear back and the boundary has not been altered. SC explained that the MCA and TH also shared this concern. SC feels, therefore, that the concerns raised two years ago have not been taken seriously. 	
2	Inshore Route (Between Holy Island and the zone eastern boundary)	
	<ul style="list-style-type: none"> SC considered the inshore route to be too narrow and that navigation in the inshore route will be restricted. Small recreational vessels rely on this route and there is a risk of these vessels being forced into the over-falls. During fine weather and in the daytime this route may be navigable, however, it would be difficult /unsafe to navigate in poor weather and at night. 	
3	Other Concerns	
	<ul style="list-style-type: none"> Deploying a mixture of device types will be a concern as this would cause confusion. In this case at full capacity it would likely have to be an Area To Be Avoided (ATBA) forcing vessels to take the inshore or outshore route. 	
4	Under Keel Clearance (UKC)	
	<ul style="list-style-type: none"> 90% of vessels recreational vessels have a draught of 3m or less. 	

	<ul style="list-style-type: none"> • A recreational vessel should not go through a swell greater than 3m. At all states of weather / tide 8m (from CD) of UKC would be required as a minimum to maintain navigation. • SC recommends that the MCA UKC methodology is utilised for the assessment of UKC. 	
5	Suggested Mitigation Measures	
	<ul style="list-style-type: none"> • Devices to be appropriately marked and lit -Trinity House to advise on this. • Locate surface devices / devices <8m below CD away from the eastern boundary. • Relocate the eastern boundary to allow 4 cables of space for the inshore passage/ to accommodate the spread of the existing tracks. • Zone boundary to be marked on navigation charts and lit. • Sub-surface devices not to be marked with buoys to maintain navigation. 	
6	Other	
	<ul style="list-style-type: none"> • SC explained that the RYA holds recreational vessel density data which could be sent to Marico. • SC pointed out that wind farms are more visible and require around 1km spacing between turbines. 	SC

Minutes of Meeting held on 17 December-2018 – Chamber of Shipping

Client: Menter Môn
 Project: Morlais Tidal Demonstration Zone
 Venue: Chamber of Shipping
 Date of Meeting: 17 December 2018 at 12:15
 Chamber of Shipping Robert Merrylees (RM)
 (COS) Fena Boyle (FB)
 Marico Marine (MM) David Foster (DF)

Item	Action item / Notes for the record	Action
1	Introductions	
	<p>DF updated RM and FB on the Morlais Navigation Risk Assessment (NRA) progress since the Chamber of Shipping (CoS)/Marico telephone conference 25 October 2018 including:</p> <ul style="list-style-type: none"> The example device layout received from the client PM 19 Nov 19; Stakeholder consultation in Holyhead (19-21 Nov 18) with: <ul style="list-style-type: none"> Fishing representative; Stena Harbour Master; Stena ferry master; Local recreational representatives; RNLI; and Irish Ferries' master. The Rochdale Approach as the detail of the device layout is not finalized. 	
2	Traffic Plots	
	<p>Ferry / Cruise Tracks</p> <ul style="list-style-type: none"> RM commented that the two weeks' summer and two weeks' winter ferry data did not cover any period when the ferries were using their "Foul Weather Route" in SW gales. RM and FB additionally commented that March/April did not reflect what was understood to be winter. Although the data is in accordance with MGN 543 DF explained that Marico had since acquired six-months winter AIS data for analysis within the NRA which contains examples of usage of the "Foul Weather Route". RM commented that: <ul style="list-style-type: none"> The standard ferry tracks overlap the northern two E/W zones; The "Foul Weather Route" passes through the northern two E/W zones plus through the northern half of the N/S zone; FB commented that the northern E/W was more of a hazard to inbound (east going) ferries as, if having to alter course to 	

	<p>starboard IAW the ColReg, it will force them close or into the northern E/W zone.</p> <ul style="list-style-type: none"> ○ RM requested that a mitigation measure of only devices below 20m CD are deployed in the northern two E/W zones and the northern half of the N/S zone be considered. ○ RM considered that Cruise ship routing was discretionary and could navigate to the west of the zones. The draught of larger cruise ships can be greater than for ferries. <p>Fishing</p> <ul style="list-style-type: none"> • RM was surprised about how few fishing vessels were contained in the radar/AIS data and expected to see more inshore activity. • DF agreed however he pointed out that the AIS and radar equipment appeared to have been working correctly judging by the number recreation and RNLI radar/AIS tracks. 	
3	Inshore Route (Between Holy Island and the eastern side of the E/W Zones)	
	<ul style="list-style-type: none"> • RM has consulted with a number of commercial coastal shipping companies and they are not overly concerned by the proposed Morlais site. • RM considered that inshore route is not practical for coastal shipping and they would navigate to the West of the Morlais zones. • RM commented that the inshore route appeared to be narrow for recreational and fishing vessels which may cause them to deviate onto other routes should surface devices be used. Should submerged devices be used, small vessels could safely navigate over. 	
4	Foul Weather Route	
	<ul style="list-style-type: none"> • FB commented that ferry companies employ the “Foul Weather Route” to reduce rolling for the safety of the passengers, crew (especially those employed in the car decks) and cargo (especially the danger of a vehicle breaking out of its sea lashings). • RM commented that extreme weather events are becoming more frequent and severe and warnings can be late in being issued. 	
5	Other Issues	
	<ul style="list-style-type: none"> • RM understood the need for the Rochdale approach but would prefer to have more detail on the device deployment plan. • RM, FB and DF discussed “Area to Be Avoided”, Safety Zones and possible charting and marking options and agree that once a definitive design had been agreed marking and charting policy should be straight forward for UKHO and TH. 	
6	Navigation Risk	
	<ul style="list-style-type: none"> • RM considered that the proposed Morlais site would increase Navigation Risk of: <ul style="list-style-type: none"> ○ Collision – squeezing traffic into a smaller area. ○ Contact (Allision) – The devices introduce new surface and submerged objects in the area. 	

	<ul style="list-style-type: none"> ○ SAR restrictions / access difficulties if surface devices are utilised and a sufficient distance for navigation is not maintained between devices. 	
7	Overall	
	<ul style="list-style-type: none"> • RM stated that the CoS supported the proposed Morlais site in principle provided that suitable navigational safety compromises and mitigation measures are agreed. 	

Minutes of Meeting held on 29-01-2019 - MCA

Client: Menter Môn
 Project: Morlais Tidal Demonstration Zone
 Venue: MCA, Commercial Road, Southampton, SO15 1EG
 Date of Meeting: 29 January 2019 at 11:00

MCA	Helen Croxson (HC)
Trinity House	Trevor Harris (TH)
Marico Marine	David Foster (DF)
Marico Marine	Rebecca Worbey (RW)
Marine Space	Phil Durrant (PD)
Menter Môn	James Orme (JO)

Item	Action item / Notes for the record	Action
1	Introduction	
	<ul style="list-style-type: none"> RW introduced that the purpose of the meeting was to revisit the Phase One consultation held in October 2018 following the completion of the Preliminary Hazard Analysis (PHA) and Approach to the NRA document. Introductions RW outlined the agenda for the meeting. 	
2	RADAR Survey Requirement	
	<ul style="list-style-type: none"> PD questioned if there is any flexibility in the requirement for RADAR survey data to be no more than two-years old at the time of license application, as specified within MGN 543. HC explained that the MCA guidance MGN 543 states that traffic surveys, including RADAR surveys, should be no more than 24-months old at the time of license application. This is considered best practice; however, operators may choose to proceed with older data at their own risk. HC explained that this may leave the data's validity open to scrutiny by stakeholders. 	
3	Review of Site Layout and Vessel Traffic - Initial Concerns	
	<p>RW explained that tidal energy is an evolving industry and as such it is difficult to commit to particular devices / layouts at this stage and as such a Rochdale / Flexible Project Envelope approach was being utilised.</p> <p>Vessel traffic plots were reviewed:</p> <ul style="list-style-type: none"> HC - The initial concern is the size of the project area. HC - Concerns over restricting the inshore route. HC reiterated that the layout once agreed will need to ensure clear lines of sight and navigational channels between devices to maintain search and rescue access especially at night, in poor visibility and high sea states. <ul style="list-style-type: none"> HC reiterated that while the MCA is supportive of Offshore Renewable Energy development, its remit is to ensure that the 	

	<p>safety of navigation is preserved, and Search and Rescue capability is maintained.</p> <ul style="list-style-type: none"> ○ Surface and surface breaking devices should, therefore, be aligned in straight rows that allow RNLI vessels to have continued access. ○ JO explained that minimum spacing between devices will largely depend upon device types. Illustrative spacing: <ul style="list-style-type: none"> ▪ 70m/80m across the tidal stream (x5 device width); and ▪ 200m/300m downstream (x15 device width) • TH explained that Trinity House often has a vessel with a heli-pad working off South Stack lighthouse which typically would be located at a distance of up to 1.5 miles off of South Stack. Should Trinity House's access to South Stack lighthouse be restricted, this would be of significant operational concern. <ul style="list-style-type: none"> ○ TH will feed PHA to operations department for comment on impact at South Stack lighthouse. • TH pointed out that there are no adequate examples of the alternative poor weather ferry routes within the passenger vessel plot. <ul style="list-style-type: none"> ○ RW explained that an additional six months of winter AIS data had been purchased which contained examples of poor weather routes including a ferry anchoring at Abraham's Bosom. • HC and TH pointed out that the fishing vessel traffic looked light with only examples of vessels en-transit passing through the Morlais Zone. <ul style="list-style-type: none"> ○ DF explained that Marico received the same feedback from local stakeholders who thought that the plot under-represented fishing particularly potting occurring frequently close to the shore. 	
4	PHA Results	
	<ul style="list-style-type: none"> • HC questioned why the hazard 'Impact to Fishing' was scored as high for both the baseline and residual risk score. <ul style="list-style-type: none"> ○ RW explained that this was due to the risk of gear catching on the devices causing both a hazard to the fishing gear and the project. It is considered, therefore, that this hazard cannot be mitigated to a level that would reduce the risk of fishing to acceptable levels and as such it is recommended that fishing be excluded within the Morlais Zone. 	
5	Mitigation Measures	
	<p>Embedded mitigation measures were reviewed. No additional embedded mitigation measures were proposed.</p> <p>HC commented that the list of proposed additional mitigation measures looked comprehensive.</p> <p>Additional Mitigation Discussion:</p> <p><u>Safety Zones</u></p> <ul style="list-style-type: none"> • Enforcement of the safety zone would be through active monitoring arrangements, including a guard boat (similar to oil and gas rigs). 	

	<ul style="list-style-type: none"> HC pointed out that Safety Zones are only really effective if there are monitoring arrangements i.e. a guard vessel on site. <p><u>“Area to be Avoided”</u></p> <ul style="list-style-type: none"> HC explained the concept of an “Area to be Avoided”. There followed a general discussion on how such an area would likely be charted by the UKHO and marked by TH. <p><u>Monitoring by Marine Co-ordination Centre</u></p> <ul style="list-style-type: none"> HC questioned what this would be. DF explained it would be the same idea as with a wind farm - a central point for managing safe and efficient operational activity. <p><u>Emergency Response Co-Operation Plan (ERCoP)</u></p> <ul style="list-style-type: none"> HC questioned where the requirement for an ERCoP will be addressed. RW explained this had been included as an embedded mitigation measure and will be included within the NRA. 	
6	Cumulative and In-Combination Impacts	
	<ul style="list-style-type: none"> HC questioned how C&IC impacts had been addressed within the PHA. RW explained that a high-level assessment had been undertaken and that Cumulative impacts will be addressed within the NRA. 	
7	Local Stakeholder Consultation	
	<p>HC enquired after the feedback received from local stakeholder consultation, particularly fishing and recreational users:</p> <ul style="list-style-type: none"> RW explained that the recreational users primary concern was that their existing routes should remain open for use and events such as the round Anglesey race could continue. As such recreational consultees would like to see adequate UKC maintained to allow continued navigation through the inshore passage. DF summarised the feedback from local consultees which included: <ul style="list-style-type: none"> There was overall support for the concept of the project; Concerns over continued access for navigation to the site; particularly the two northern-most zones for the ferries and the eastern boundary for recreational and smaller craft. DF explained that stakeholders discussed UKC in detail and that two key depths were established that stakeholders felt would ensure continued navigation which were: 20m (large vessels such as ferries) and 8m smaller craft of draught <3m. 	
8	Other comments	
	<p><u>Guidance</u></p> <p>HC pointed out that there had been some updates to existing legislation / guidance:</p> <ul style="list-style-type: none"> Annex 5 of MGN 543 – Revised ERCoP / SAR guidance IMO circular in relation to updated FSA Guidance (with reference to MGN 543) 	

	<p><u>Programme</u></p> <ul style="list-style-type: none"> • 2020 Consent; • 2023 Complete shore installation; and • 2023 First phase of installation of devices (Small area). <p><u>Project Life</u></p> <ul style="list-style-type: none"> • HC questioned what the life of the project will be. • JO – 45-year lease, of which 40 years remains <ul style="list-style-type: none"> ◦ 25-year design life – however, devices may be switched out every 5 years. A 30-year design life could potentially be aimed for. <p><u>Layout</u></p> <p>HC questioned when a device specific layout would be available.</p> <ul style="list-style-type: none"> • JO estimated that this would be available in 2021/2022. <p><u>Marking and Lighting</u></p> <ul style="list-style-type: none"> • TH pointed out that until a device specific layout is available, Trinity House will not be able to comment on how the site/ devices should be marked. If this is not received prior to the license application, marking plans will be past comment. • It is Trinity House's preference that devices and buoys not be marked with AIS as the over proliferation of AIS can cause confusion on ships' radar and ECDIS displays. <p><u>Cable</u></p> <p>TH questioned if the cable would be buried.</p> <ul style="list-style-type: none"> • RW explained that the cable would not be buried, however, would be protected. • JO confirmed that the plan for the cable is Horizontal Directional Drilling (HDD) to a point 300m offshore. If not feasible, then cable will be run up the beach. • HC pointed out that the MCA will accept a maximum 5% reduction in charted depth. <p><u>Moorings</u></p> <ul style="list-style-type: none"> • HC questioned how moorings were being assessed. • Review of the mooring arrangements for floating turbines should be carried out in accordance with the MCA and HSE Guidance 'Regulatory expectations on moorings for floating wind and marine devices', which also include Third Party Verification. • RW explained that, in the absence of a device layout moorings have not been assessed. <p><u>License Application Process</u></p> <ul style="list-style-type: none"> • JO explained that the project is applying for consent under the Transport and Works Act. As such there is no formal PEIR process. 	
9	Ongoing Consultation	

	<p>HC explained that the MCA would like to receive a copy of the NRA as soon as possible; following which, a consultation meeting should be held between the MCA, Trinity House and Menter Môn / Marine Space.</p> <p><u>NRA Review Process</u></p> <ul style="list-style-type: none"> • HC explained that once the NRA was received the MCA will undertake consultation with its own stakeholders before making a decision on the NRA. • HC - Key to progress will be the scope to discuss the potential reduction of the boundary where traffic is focused, and device locations within the site, depending on the outcome of the NRA. 	
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Email Consultation Minutes – Trinity House

Client: Menter Môn
Project: Morlais Tidal Demonstration Zone
Consultee: Trinity House Operations

Trinity House	Ross Chadwick
Trinity House	Simon Millyard
Marico Marine	Rebecca Worbey
Marico Marine	David Foster

From: Ross Chadwick

To: Rebecca Worbey, David Foster

Cc: Simon Millyard

Sent: 20 February 2019 09:46

Subject: RE: Morlais Tidal Development near South Stack - Trinity House Marine/Operations

Good day

Trinity House is required under the Merchant Shipping act 1936 to provide and maintain Aids to Navigation around the coasts of England, Wales, The Channel Islands and Gibraltar. This proposal to restrict shipping in the vicinity of South Stack Lighthouse will impair the ability of Trinity House to carry out its statutory duty to maintain South Stack Lighthouse as part of its routine maintenance activities. To deliver and retrieve any heavy or bulky items to South Stack Lighthouse requires the use of one of the Trinity House ships and the helicopter working off the ships flight deck and delivering to the helipad at the Lighthouse. In order to carry out this, the ship will typically station itself c. 0.75NM off South Stack Lighthouse for the duration of the helicopter operations. To work the helicopter with the ship in a remote location is expensive in time and helicopter running costs and adds challenge to the operation working over longer distances and out of line of sight.

In order to facilitate this, a safe passage route clear of any surface obstructions and with minimum 10m depth and a suitably sized operations area between 0.5NM and 1.0NM off the Lighthouse needs to be provided for in the design of the proposed equipment locations.

The positioning of the vessel would also be variable during helicopter operations due to the large tides in this area and also taking into account any shelter required.

The area required for Trinity House operations is shown on the chart below with the 2 radii set at 0.5 and 1.0nm. plus a safe route into and out of this area of .025NM wide ideally running East West.

The intersections are as follows:

A – 53°19'.401 N 004°41'.987 W
B – 53° 18.987 N 004°41'.584 W
C – 53°18.908 N 004°41'.964 W
D - 53°17'.912 N 004°42'.128 W
E - 53°17'.630 N 004°41'.930 W
F - 53° 17'.402 N 004°42'.106 W



Please ensure that the undersigned along with Mr Simon Millyard (contact details below) as operational stakeholders in the area are included in any further risk analysis or stakeholder engagements.

Best regards

Ross