



MENTER MÔN

NAVIGATION RISK ASSESSMENT ADDENDUM– MORLAIS DEMONSTRATION ZONE



Report Number: 20UK1647
Issue: Issue 02
Date: 18-09-2020



British
Ports
Association



International Harbour
Masters Association



MARINE AND RISK CONSULTANTS LTD

MENTER MÔN

NAVIGATION RISK ASSESSMENT ADDENDUM– MORLAIS DEMONSTRATION ZONE

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| Date | Release | Prepared | Authorised | Notes |
|------------|----------|----------|------------|---------------------------|
| 10-09-2020 | Draft A | RW, DF | AC | Draft Issued for Comments |
| 15-09-2020 | Draft B | RW | AC | Responses to comments |
| 17-09-2020 | Issue 01 | RW | AC | Responses to comments |
| 18-09-2020 | Issue 02 | AC | AC | Final Issue |

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18-09-2020

EXECUTIVE SUMMARY

Menter Môn requested Marine and Risk Consultants Ltd (Marico Marine) complete an independent Navigation Risk Assessment Addendum to assess the impact of the construction and operation of the Morlais Demonstration Zone (MDZ) Project, west of Holy Island, off Anglesey, to existing shipping and navigation.

The NRA Addendum updates and extends the previous NRA completed by Marico Marine in 2019 and seeks to assess the layout changes introduced since completion of the 2019 NRA and to elaborate and provide further clarity around elements concerning navigational risk raised by navigational stakeholders since completion of the 2019 NRA assessment utilising newly available data, including the HR Wallingford Coastal Process report.

The primary changes to the Morlais Development Zone layout since the previous assessment include the adoption of the following recommendations from the 2019 NRA:

- The introduction of a zone of 8m minimum UKC to the east of the MDZ adjacent to the inshore route; and
- The introduction of a zone of minimum 20m UKC along the northern, west and southern MDZ boundaries.

Because of these changes to the design, the developer felt that it would be appropriate and responsible for the NRA to be reviewed and updated to take account of these changes so that the NRA is based on the most up-to-date project design available, while also allowing stakeholders the opportunity to comment upon the design changes.

This NRA seeks to quantify the navigation risk as a result of these changes and provides supplementary information to the Environmental Statement and application submitted in September 2019 for a Marine Licence under the Marine Planning and Coastal Access Act 2009 and a Transport and Works Act Order.

The NRA methodology is based on the International Maritime Organisation's Formal Safety Assessment approach to risk management utilising a combination of data analysis and stakeholder/expert judgement to determine risk levels. Please note, the Navigation Risk Assessment considers safety of navigation and does not seek to address any possible loss of amenity.

The navigation risk assessment was undertaken informed by stakeholder consultation and vessel traffic data from the Automatic Identification System, RADAR and a variety of secondary sources including the RYA Coastal Atlas, the HR Wallingford Coastal Processes Modelling Report and navigational incident data.

Baseline traffic density within and within vicinity to the MDZ was identified to be generally low. There is little commercial shipping within or close to the MDZ with tankers and large cargo vessels utilising the Off Skerries TSS. The primary large vessels (>3m draught) operating in vicinity of the MDZ are ferries which operate to the north. Fishing is mainly by small vessels and occurs in and around the MDZ, with potting activities close to shore. However, fishing effort is generally low at <20,000 kWh per year. The inshore route is used primarily by small vessels particularly recreational vessels numbers of which increase significantly in summer. Comparatively, few small vessels were recorded utilising the identified western route. The navigation profile as assessed from AIS, RADAR and additional means corroborates the views expressed by stakeholders during consultation with regard to the baseline navigation profile in the area of the MDZ.

The MDZ lies in an area of challenging metocean conditions and a hazardous lee-shore. The Imray Sailing Directions for Anglesey states that *'In the event that there is any sign of a tide race off either Stack it may be advantageous to stand in close to the cliffs and cut through the race as near as possible to the rocks. It may be dangerous to attempt passage round the Stacks, in either direction, in any sort of wind over tide conditions or with winds of Force 5 or greater....In heavy conditions an offing of 7 miles is needed to avoid overfalls and tide races.'* Changes in tidal stream rates and wave heights resulting from the presence of the MDZ were assessed within the HR Wallingford report and identified to have little additional impact over the existing challenging sea conditions.

Following vessel traffic analysis and stakeholder consultation a risk assessment was undertaken of both the area encompassing the MDZ and the MDZ itself to assess the navigation risk during both the construction and operation phases of the project. A total of 85 hazards were identified for assessment in the construction phase and 70 within the operational phase.

All hazards were assessed to be ALARP or lower in the baseline risk assessment. Of the 85 hazards assessed within the construction phase 19 were scored as ALARP in the baseline assessment. Of the 70 hazards assessed within the operation phase assessment, 6 were scored as ALARP in the baseline assessment. For those hazards scored as ALARP the implementation of mitigation measures should be considered to further reduce risk. A full list of suggested mitigation measures and the respective phases to which they apply are shown below:

| ID | Risk Control | Phase | |
|----|--|--------------|-----------|
| | | Construction | Operation |
| 1 | Continuous Monitoring by Marine Co-ordination Centre | X | X |
| 2 | Restrict Navigation through the Gold and Green MDZ Zones | X | X |
| 3 | MDZ designation as No Fishing Zone | X | X |
| 4 | Appropriate alignment and spacing of devices | X | X |
| 5 | Check device surveys | X | X |
| 6 | Guard vessel to monitor passing traffic | X | |
| 7 | Establish no anchoring areas | X | X |
| 8 | Enhanced cable protection | X | X |
| 9 | Implementation of Safety Zones | X | |
| 10 | Temporary navigation aids as required by Trinity House | X | |
| 11 | Undertake Device / Array Specific Risk Assessments to include NavAids and Marker Buoys | X | |
| 13 | Provision of life saving equipment on fixed structures and floating devices | X | X |

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).

With the introduction of the suggested mitigation measures 6 hazards were assessed to be ALARP in the construction phase residual risk assessment and 3 within the operational phase risk assessment. All remaining hazards were assessed to be low or lower.

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 a minimum required UKC to be maintained allowing safe transit, marking of devices in accordance with TH requirements will be required in order to mitigate contact hazards. The following points are further noted in this regard:

- Marking and lighting is a key mitigation measure embedded within the project of which the details cannot be supplied by Trinity House until a more detailed device specific layout is available. Marking and lighting is assumed to evolve over the life of the project reflecting the phased installation approach. The exact location, number and nature of the marking and navigation buoys will be determined through consultation with Trinity House (TH), the

Maritime and Coastguard Agency (MCA) and navigation stakeholders. Further device / array specific risk assessments including NavAids are suggested as the device specific layout develops.

- The restriction of navigation through the gold and green zones is an effective mitigating measure against contact and snagging hazards, however, its adoption will need to be balanced against loss of freedom of navigation by the regulator.
- The restriction of fishing within all zones of the MDZ is an effective mitigation measure against snagging / obstruction including with mooring systems, cables and export cables in addition to contact hazards. This is particularly effective taking into account the worst-case device layout. Its adoption will need to be reviewed by the project in consultation with the MCA and the regulator.
- The presence of devices within the gold and green MDZ zones will impact on vessels running for shelter from the south west. This has been considered as a causal factor within the risk assessment and assessed. Prior to the deployment of any devices an Emergency Response Co-operation Plan (ERCOP) will need to be agreed with the MCA and Trinity House. This will include details of access to a safe havens and places of refuge in the event of an emergency or stress of weather.
- Minimising use of marker buoys within the purple and blue areas is recommended, particularly in zones of minimum UKC in order to minimise obstructions and maximise areas of safe navigation.

The changes introduced to the layout since completion of the 2019 NRA Assessment, primarily:

- i) the introduction of the area of minimum 8m UKC adjacent to the inshore route (blue area);
- ii) the introduction of an area of minimum 20m UKC along the northern, west and southern MDZ boundaries (purple area) are assessed to:
 - i. widen the channel to 1,000m reducing the effect of traffic squeezing in the inshore passage and reduces the risks to small vessels presented by the original design, in particular risks associated with grounding / forced ashore

(which was scored as significant for recreational vessels within the 2019 NRA) and collision to small vessels (<3m draught).

- ii. increase the area for safe navigation of vessels, particularly of >3m draught including for ferries during both fair and poor weather routeing.

The Project is therefore assessed to be acceptable in terms of navigational risk assuming compliance with embedded and implementation of suggested additional mitigation measures where appropriate for hazards scoring as ALARP.

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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 |
| CA | RYA Coastal Atlas of Recreational Boating |
| CD | Chart Datum |
| CGOC | Coast Guard Operation Centre |
| CHA | Competent Harbour Authority |
| COLREGS | International Regulations for Preventing Collisions at Sea |
| CPMR | Coastal Processes Modelling Report (HR Wallingford) |
| DfT | Department for Transport |
| DP | Dynamic Positioning |
| 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 |

| Abbreviation | Detail |
|----------------------|--|
| LAT | Lowest Astronomical Tide |
| 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 |
| MDZ | Morlais Demonstration Zone |
| MGN | Marine Guidance Note |
| ML | Most Likely |
| MMO | Marine Management Organisation |
| MSI | Maritime Safety Information |
| MW | Megawatts |
| nm | Nautical Mile |
| NRA | Navigation Risk Assessment |
| NSMS | Navigational Safety Management System |
| NTM | Notice To Mariners |
| OREI | Offshore Renewable Energy Infrastructure |
| PA | Precautionary Area |
| PDE | Project Design Envelope |
| 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 |

| Abbreviation | Detail |
|--------------|---|
| SWAN | Simulating Waves Nearshore |
| TEC | Tidal Energy Converter |
| THLS | Trinity House Lighthouse Service |
| TSS | Traffic Separation Schemes |
| UKC | Under Keel Clearance |
| UXO | Unexploded Ordnance |
| 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) complete an independent Navigation Risk Assessment (NRA) Addendum to assess the impact of the construction and operation of the Morlais Demonstration Zone (MDZ) Project, west of Holy Island, off Anglesey, to existing shipping and navigation.

The NRA Addendum updates and extends the previous NRA completed by Marico Marine in 2019¹ and seeks to assess the layout changes introduced since completion of the 2019 NRA and to elaborate and provide further clarity around elements concerning navigational risk raised by navigational stakeholders since completion of the 2019 NRA assessment utilising newly available data, including the HR Wallingford Coastal Process report.

The primary changes to the MDZ layout since the previous assessment include the adoption of the following recommendations from the 2019 NRA:

- The introduction of a zone of 8m minimum UKC to the east of the MDZ adjacent to the inshore route (**Figure 1**);
- The introduction of a zone of minimum 20m UKC along the northern, west and southern MDZ boundaries (**Figure 1**).

Because of these changes to the design the developer felt that it would be appropriate and responsible for the NRA to be reviewed and updated to take account of these changes so that the NRA is based on the most up-to-date project design available, while also allowing stakeholders the opportunity to comment upon the design changes.

This NRA seeks to quantify the navigation risk as a result of these changes and provides supplementary information to the Environmental Statement (ES) and application submitted in September 2019 for a Marine Licence under the Marine Planning and Coastal Access Act 2009 and a Transport and Works Act Order (TWAO).

The NRA methodology is based on the International Maritime Organisation's (IMO) Formal Safety Assessment (FSA)² approach to risk management utilising a combination of data analysis and

¹ 18UK1479_MorlaisNRA_Issue03

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

stakeholder/expert judgement to determine risk levels. Please note, the Navigation Risk Assessment considers safety of navigation and does not seek to address any possible loss of amenity.

1.1 GUIDANCE

Guidance on the assessment requirement was primarily sought from the MCA Marine Guidance Note (MGN) 543 (M+F) 'Guidance on UK Navigational Practice, Safety and Emergency Response Issues'³ which replaces MGN 371. MGN 543 advises the correct methodology to evaluate navigational safety around OREIs, and this report adheres to this standard accordingly (**Annex G**). The full list of guidance utilised within the NRA is outlined within **Table 1-1**.

Table 1-1: 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. |
| MCA - Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response. | MCA policy, guidance, advice and specific requirements to assist and enable Search and Rescue, and other emergency response within, and in the vicinity of offshore renewable energy installations (OREI). |
| International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA AISM) 0-139 the | Guidance to national authorities on the marking of offshore structures. |

³ MGN 543 (M+F), (2016) Guidance on UK Navigational Practice, Safety and Emergency Response Issues

| Policy / legislation | Key provisions |
|--|--|
| Marking of Man-Made 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. |
| International Regulations for Preventing Collisions at Sea 1972 (as amended) (ColRegs) | Guidance to prevent collisions at sea. |

1.2 REFERENCE DOCUMENTS

The NRA has additionally been undertaken drawing on the input data and documents outlined within **Table 1-2**.

Table 1-2: Reference Documents

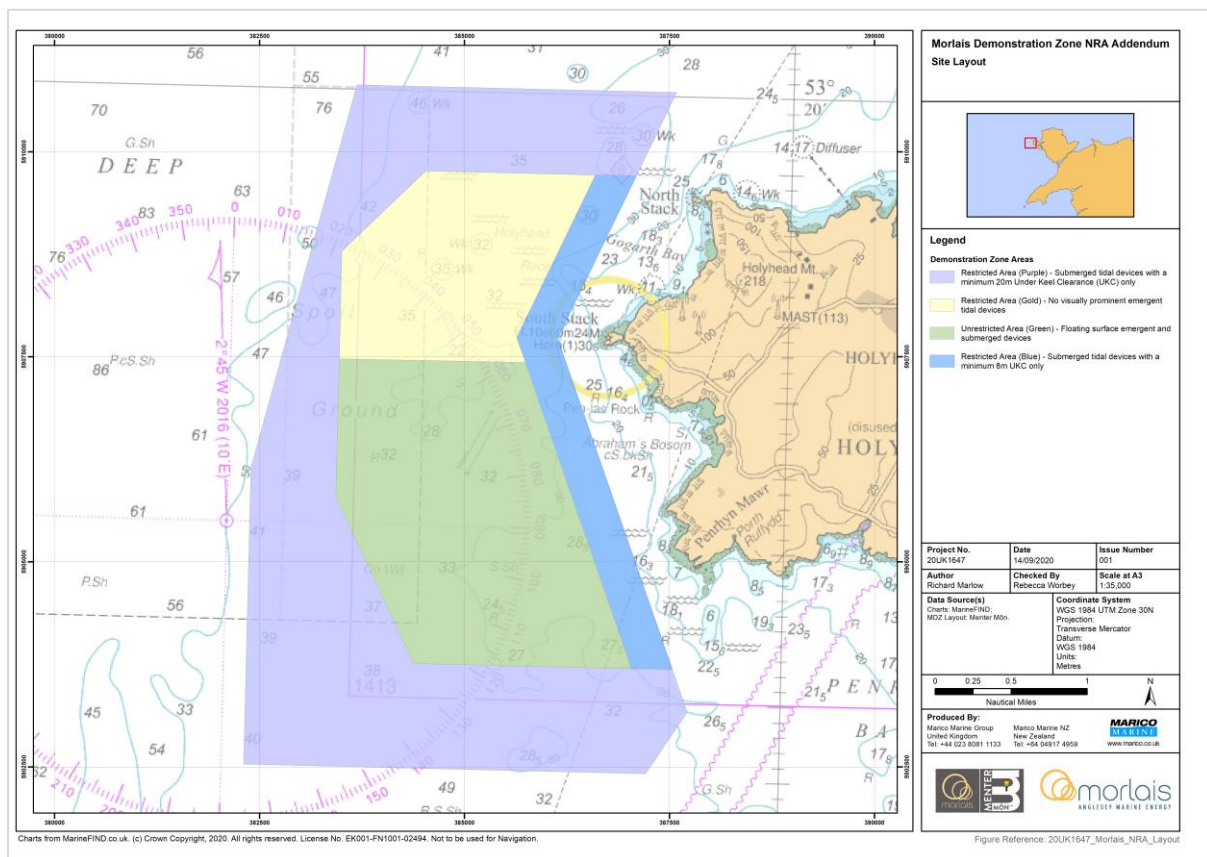
| | |
|-----------------------------|--|
| 18UK1479_MorlaisNRA_Issue03 | 2019 Navigation Risk Assessment of the Morlais Development Zone. |
|-----------------------------|--|

| | |
|--|--|
| 20UK1619_RN_MM_VTS02-02 | Interactive Boundary Assessment of the northern and eastern MDZ boundaries in accordance with MGN 543, Annex 3. |
| 06_MOR-HRW-DOC-0001_HR Wallingford Coastal Processes Modelling Report | To assess the impact of the proposed MDZ development on coastal processes, including tidal currents, waves, and sediments. |
| United Kingdom Hydrographic Office (2014) Admiralty Sailing Directions West Coast of England and Wales Pilot; NP37, 19th Edition | Outlines meteorological and metocean conditions and general guidance in navigation in the area. |
| Imray Sailing Directions for Anglesey C52 Admiralty 1413 – Anglesey – Holyhead Bay | Specific passage guidance for navigation in vicinity of Holy Island. |
| 02_MOR_RHDHV_DOC-0004ES Chapter Description (005) | Morlais Environmental Statement Project Description – Chapter 4, Volume I |
| RYA Passage Planning Guidance | Overall safety and passage planning for recreational craft. |
| Go Paddling Kayak guidance and safety checklist | Overall safety and planning for small recreational craft. |

2 DESCRIPTION OF SITE

2.1 STUDY AREA

The location and layout of the proposed MDZ is shown within **Figure 1**. The MDZ is located to the west of Holy Island, Anglesey, 500m off South Stack. The MDZ occupies a total area of 35 sq.km and has been sub-divided in to four separate areas; two areas defined based on visual characteristics of which one is for surface emergent devices (green) and one for sub-surface devices (gold) and two further areas based on minimum Under Keel Clearance (UKC) (blue and purple) which will support the installation and commercial demonstration of multiple arrays of tidal energy devices, to a maximum installed capacity of 240 Megawatts (MW). Also shown are indicative electrical hub locations.



2.2 BACKGROUND

The MDZ 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. The

project has a 45-year lease which commenced in 2014 and will have a 37-year design life. Construction is to commence by 2023 and will likely take a phased deployment approach.

The project seeks consent for a broad Project Design Envelope (PDE) to ensure flexibility in deployment of devices as the technology evolves over time. Subsequently, the location and routing of inter-array and export cables (up to nine assumed), which are to make landfall at Abraham's Bosom, and associated electrical hubs which may extend up to 18 m above the sea surface at LAT (up to nine assumed), and the specific types of turbines to be deployed have not yet been determined. The NRA therefore assumes the potential for utilisation of one of, or a combination of; sea-bed mounted, mid-water or surface devices (see **Table 2-1**) in accordance with the zones outlined in **Figure 1**.

Consideration of a broad PDE is particularly important for the following areas relevant to the assessment of shipping and navigation risk, which will be further developed via detailed design work post consent:

- The total number of tidal devices deployed within the MDZ;
- Layout of tidal devices within the MDZ (location, density, array spacing);
- Device types;
- Foundation/mooring types;
- Location of electrical hubs and monitoring equipment;
- Number and routing of inter-array and export cables; and
- Location and lighting/marketing requirements of navigational aids.

Dependent on the type of tidal device, full deployment to a worst-case of 240 MW could comprise up to a maximum of 620 tidal devices, supporting up to 1,648 TECs and up to 740 inter-array cables within the MDZ. Up to 9 export cables will be installed between the MDZ and the landfall at Abraham's Bosom. Due to the hard and rocky nature of the seabed, it is expected that the majority of the cables will be free laid with protection such as rock bags, concrete mattresses or split-pipe at locations along the length. Installation of export and array cables could require a medium sized cable installation vessel (up to 140 m long and 6 m draft), plus barge (could be up to 130 m long x 30 m wide) for installation of rock bags / mattresses (30 m long x 12 m wide), with a small additional support vessel for each.

The device installation methodology to be adopted will depend on the device types to be installed. Example construction vessels may include:



- moored barges - for example: 100 m x 30 m and have four to eight 100 tonne gravity blocks (5 m by 5 m) or drag anchors (3 m x 5 m) with some anchor chain catenary, estimated at 400 m to 500 m length on seabed and 1 m diameter.
- support vessels (30 m x 22 m) to assist with moored barge positioning and anchor deployment.
- Dynamic Positioning (DP) vessel (approximately 155 m x 30 m) with craneage (250 t to 400 t)
- Multicat vessels

During the operational phase developers are expected to visit each array/ tidal device up to 15 times annually for planned and unplanned maintenance. Vessels utilised for maintenance will typically be a workboat or multicat. In the event that the removal of a tidal device is required, such as retrieval and repair following structural failures for example, a large multicat or possibly offshore DP vessel may be required, dependent upon device type.

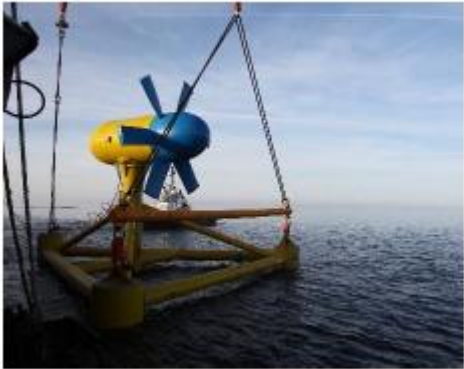


2.3 PROPOSED TIDAL DEVICES


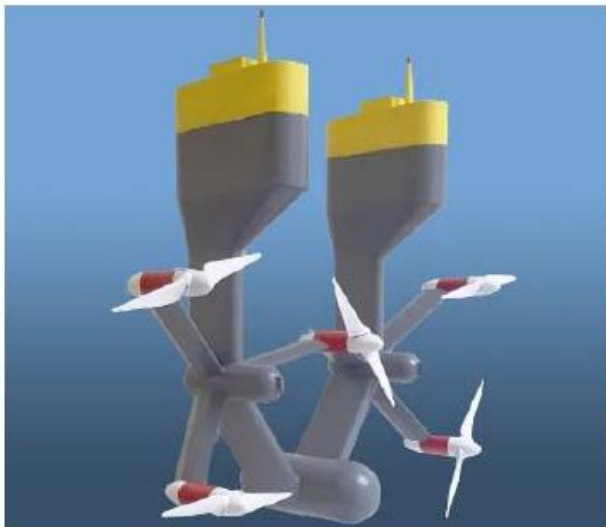
A range of example devices that could be deployed within the MDZ are given within **Table 2-1**.

Table 2-1: Examples of Tidal Energy Converters (TEC) that could be deployed in the MDZ⁴

| Sub-Category | Exemplars (Developer or Device Names) | |
|---|---|---|
| Category 1 : Seabed Mounted Sub-Surface Devices | | |
| Large rotor(s) (>10 m diameter) | <ul style="list-style-type: none"> • SIMEC Atlantis Energy • Andritz Hydro Hammerfest |  <p>Developer: SIMEC Atlantis Energy Source: (https://twitter.com/simecatlantis/status/534996023178178560)</p> |
| Small (<10 m diameter) rotors | <ul style="list-style-type: none"> • Verdant Power • QED Naval SubHub • Nova Innovation • Sabella |  <p>Device/Developer: Gen5Tidal/Verdant Power Source: Verdant Power</p> |

⁴ 02_MOR_RHDHV_DOC-0004ES Chapter Description (005)

| Sub-Category | Exemplars (Developer or Device Names) |
|---|---|
| |  <p>Device/Developer: D10-1000/Sabella Source: Sabella</p> |
| <p>Vertical Axis Turbine</p> | <ul style="list-style-type: none"> • Repetitive Energy  <p>Developer: Repetitive Energy Source: http://www.repetitiveenergy.com/ourtechnology</p> |
| Category 2: Mid-water Column Devices | |
| <p>Multiple small (<10 m diameter) rotor upon submerged buoyant platform</p> | <ul style="list-style-type: none"> • SME PLATO platform or similar with Tocardo or Schottel TECs • Renewable Devices • Marine Ltd.  <p>Developer: Renewable Devices Marine Ltd.</p> |

| Sub-Category | Exemplars (Developer or Device Names) | |
|---|--|---|
| | | Source: https://www.theenergytimes.com/distributedenergy-ecosystem/scots-push-new-tide-turbine-tech |
| Category 3: Floating or Surface Emergent Devices | | |
| Large rotor (>10 m diameter) floating or emergent devices | <ul style="list-style-type: none"> Orbital Marine Power Magallanes |  <p>Developer: Orbital Marine Power</p> <p>Source: https://marineenergy.biz/2018/11/16/orbitalmarine-unveils-o2-turbine-blueprints/</p> |
| Small rotor (<10 m diameter) floating devices | <ul style="list-style-type: none"> Tocado TFS |  <p>Developer: Tocardo</p> <p>Source: https://marineenergy.biz/2018/06/06/-tocardo-strengthens-management-with-financeappointments/</p> |

| Sub-Category | Exemplars (Developer or Device Names) |
|---|--|
| | <div data-bbox="785 353 1310 651" data-label="Image"> </div> <p data-bbox="756 703 1002 734">Developer: Instream</p> <p data-bbox="756 772 1382 857">Source: https://www.marineenergywales.co.uk/-instream-and-itpenergised-full-scale-demonstrator/</p> |
| <p data-bbox="204 1151 424 1375">Large rotor (>10 m diameter) surface emergent spar buoy</p> | <ul style="list-style-type: none"> <li data-bbox="469 1249 604 1281">• Aquantis <div data-bbox="769 902 1236 1491" data-label="Image"> </div> <p data-bbox="756 1545 1002 1576">Developer: Aquantis</p> <p data-bbox="756 1597 1262 1628">Source: https://www.f6s.com/aquantisinc</p> |

3 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, contact, grounding, breakout, swamping risk etc.;
 - c. Cable risk, including snagging;
 - d. Search and Rescue; and
 - e. Cumulative and In-Combination Effects.
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.

4 OVERVIEW OF THE BASELINE MARINE ENVIRONMENT

4.1 METOCEAN CHARACTERISTICS

The MDZ is located over and adjacent to exposed bedrock. The seabed across the MDZ is dominated by outcropping rock at surface and coarse sediment types such as gravel, with consistent boulders overlaying. The average water depth across the MDZ is 40m Lowest Astronomical Tide (LAT) and reach over 72m in the northwest of the site.

4.1.1 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.⁵

4.1.2 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. The prevailing winds in the area of the MDZ are in the south-westerly quadrant with south-westerly gales considered the most severe resulting in a lee shore hazard.

It was reported in consultation that waves greater than 5m are unusual within the vicinity of the MDZ. The roughest seas are experienced with winds from between the south and north-west with extreme waves most dominant from 210°N₆. 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. It was noted in consultation that seas in the vicinity of the Holyhead Deep to the west can be particularly rough (**Annex E**).

4.1.3 Tidal Conditions

The tidal stream is generally 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

⁵ United Kingdom Hydrographic Office (2014) Admiralty Sailing Directions West Coast of England and Wales Pilot; NP37, 19th Edition.

⁶ 06_MOR-HRW-DOC-0001_HR Wallingford Coastal Processes Modelling Report

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 known as South Stack (53°18'.41N 4°41'.98W) which lies close off the western extremity of Holy Island and is connected to it by means of a bridge with dangerous tidal races to the west.

Tidal streams in the vicinity of South Stack begin as outlined within **Table 4-1**.

Table 4-1: Tidal Stream in the Vicinity of South Stack

| Interval from HW Holyhead | Direction |
|---------------------------|-----------|
| -0605 | NNE |
| +0020 | SSW |

Table 4-2 gives the tidal diamond for the area around the proposed MDZ. Tidal flows are high, reaching maximum spring flow rates in both directions of up to 5 knots.

Table 4-2: 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 |

4.2 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.

4.2.1 HM Coastguard SAR Helicopter Base

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

4.2.2 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 MDZ are given within **Table 4-3**. At each of these stations crew and lifeboats are available on a 24-hour basis throughout the year.

Table 4-3: RNLI Stations near to the MDZ

| 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 |

4.3 SHELTER

Shelter is listed within the ASD as available at all times in Holyhead Outer Harbour. It was noted in by recreational stakeholders in consultation (**Annex E**) that *'Holyhead is the only nearby safe-haven for running for shelter. Caernarvon is not accessible during poor weather'*.

4.4 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.

4.5 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.

4.6 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**).

4.7 ANCHORAGES

Anchorage in vicinity of the proposed MDZ are given within **Table 4-4**. It was noted in consultation that ‘recreational vessels anchor in Abraham’s Bosom, however, it is not an overnight anchor’ (**Annex E**).

Table 4-4: 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 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. |

4.8 OFFSHORE RENEWABLE INFRASTRUCTURE (OREI)

OREI’s within the vicinity of the MDZ are given within **Table 4-5**. The nearest OREI to the MDZ is the Minesto operated Holyhead Deep tidal demonstration site located 1km to the west of the proposed MDZ.

Table 4-5: 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 |

4.9 OIL AND GAS

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

4.10 MARINE AGGREGATES

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

Table 4-6: 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 |

4.11 DREDGE DISPOSAL SITES

There is a spoil ground, Holyhead North located to the west of the MDZ 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 MDZ⁷. The spoil ground is marked by a lit buoy.

4.12 DIVING BOATS

There are a number of wreck features within and around the MDZ. No historic wrecks are present. It was identified within consultation that wreck diving occurs within the MDZ 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 MDZ. A collision involving a dive boat was identified from MAIB incident data within 1nm of the MDZ (see **Section 8**).

⁷ MMO (2017) Scoping Opinion; Port of Holyhead – Holyhead Port Expansion: DC10119

4.13 EXERCISE AREAS

There are no active 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 MDZ.

4.14 SUB-SEA CABLES

There are two sub-sea cables in close proximity to the south-east corner of the MDZ. The cables which include; the Emerald Bridge cable and Celtic Connect cable, make landfall on the west coast of Holy Island near Porth Dafarch, north of Trearddur Bay.

4.15 PIPELINES

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

4.16 EXPLOSIVE DUMPING GROUNDS

There are no explosive dumping grounds in the vicinity of the site. No presence of Unexploded Ordnance (UXO) is indicated within the MDZ.

5 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.

6 DATA SOURCES

Data analysis of the baseline data seeks to quantitatively determine the extent of navigation in the vicinity of the MDZ 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 MDZ and their tracks;
 - Gate analysis to discover the frequency and distribution of vessels transiting the area; and
 - Vessel traffic density.

6.1 DATA COLLECTION

Marico has undertaken the NRA utilising the following data sources:

- Automatic Identification System (AIS) data (**7.1.1**);
- RADAR data (**Section 7.1.3**);
- GIS shapefiles (including recreational user data);
- RYA Coastal Atlas of Recreational Boating (**Section 7.3.8**);
- Maritime Incident Data (Maritime Accident Investigation Branch (MAIB) 1997-2017 and RNLI Callouts 2008 to 2016 (**Section 8**);
- Stakeholder Consultation (**Section 6.2, Annex D and Annex E**).
- 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).

6.2 STAKEHOLDER CONSULTATION

Stakeholder consultation was undertaken with local and national consultees, as part of the Preliminary Hazard Analysis (PHA) initially (Phase 1 - National), the 2019 NRA (Phase 2 – Local and National) and the NRA Addendum in accordance with MGN 543. **Table 6-1** includes a summary of NRA Addendum consultation feedback relevant to shipping and navigation. The full minutes from both the NRA

Addendum stakeholder consultation and 2019 NRA consultation are contained within **Annex D** and **Annex E** respectively.

Table 6-1: NRA Addendum Stakeholder Consultation Meetings

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|--|--|--|----------------------------------|
| Chamber of Shipping (Teleconference 06 August 2020) | <ul style="list-style-type: none"> The new layout appears to be a positive step forward. Introduction of the 20m UKC zone to be an adequate compromise and safety provision. | <ul style="list-style-type: none"> Zone of 20m minimum UKC embedded in project design and risk assessment as an embedded mitigation measure. | Section 11.4 |
| | | <ul style="list-style-type: none"> Effectiveness of introduction of 20m UKC embedded mitigation measure assessed within the baseline risk assessment. | Annex B Annex C |
| | <ul style="list-style-type: none"> The 20m UKC zone does still see a fair amount of traffic and ferries are still noted crossing the 'gold zone', however, the introduction of the zone of 20m UKC should now allow vessels to safely pass to the north of the 'gold' zone. | <ul style="list-style-type: none"> Effectiveness of introduction of 20m UKC embedded mitigation measure assessed within the baseline risk assessment. | Annex B Annex C |
| | <ul style="list-style-type: none"> Diverting around the edge [of the MDZ] should not be an issue for cruise ships which are required to keep an adequate distance from the coastline. | <ul style="list-style-type: none"> Impact upon shipping and navigation risk to cruise ships assessed within the baseline risk assessment. | Annex B Annex C |
| | <ul style="list-style-type: none"> Coaster traffic frequency through the MDZ is low. Their diversion to the west of the site would be relatively minor. | <ul style="list-style-type: none"> Impact upon shipping and navigation risk to coasters assessed within the baseline risk assessment. | Annex B Annex C |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|-----------|---|---|--|
| | <ul style="list-style-type: none"> In terms of poor weather routeing; the changes introduced represent a pretty good compromise in terms of navigation safety. | <ul style="list-style-type: none"> Effectiveness of introduction of 20m UKC embedded mitigation measure assessed within the baseline risk assessment. | <p>Annex B Annex C</p> |
| | <ul style="list-style-type: none"> The boundary between the purple and gold areas will need to be clearly marked, particularly if sub-surface devices are installed in the gold zone that are not surface piercing and which do not allow 20m UKC for ferry navigation. Marking of the and NE and NW corners will be the most important. | <ul style="list-style-type: none"> Mitigation measure 'Marked in accordance with Trinity House' embedded into project. | Section 11.4 |
| | | <ul style="list-style-type: none"> Additional mitigation measure 'Minimise use of marker buoys in zones of minimum UKC' suggested. | Section 13 |
| | | <ul style="list-style-type: none"> Additional mitigation measure 'Undertake device / array specific Risk assessments to include NavAids and marker buoys' suggested. | Section 13 |
| | <ul style="list-style-type: none"> Freedom of navigation supported by adequate information and marking would be preferred [to restriction of navigation]. | <ul style="list-style-type: none"> Additional mitigation measure 'Restrict Navigation through the Gold and Green MDZ Zones' suggested in baseline assessment. | <p>Annex B Annex C</p> |
| | | <ul style="list-style-type: none"> Effectiveness of suggested additional mitigation measure 'Restrict Navigation | <p>Annex B Annex C</p> |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|-----------|---|--|----------------------------------|
| | | through the Gold and Green MDZ Zones' assessed in residual assessment. | |
| | <ul style="list-style-type: none"> No increase in risk of collision identified for the western route around the MDZ. | <ul style="list-style-type: none"> Collision identified as a primary hazard for assessment across all vessel and device types. | Section 11.2 |
| | | <ul style="list-style-type: none"> Baseline and residual collision hazards assessed for all phases. | Annex B Annex C |
| | <ul style="list-style-type: none"> The risk of collision [for the inshore route] would likely be reduced in comparison to the previously assessed NRA design following implementation of mitigation. | <ul style="list-style-type: none"> Collision identified as a primary hazard for assessment across all vessel and device types. | Section 11.2 |
| | | <ul style="list-style-type: none"> Collision hazards assessed for all project phases within the baseline and residual risk assessments. | Annex B Annex C |
| | <ul style="list-style-type: none"> The presence of structures in the water will increase contact risk. | <ul style="list-style-type: none"> Contact identified as a primary hazard for assessment across all vessel and device types. | Section 11.2 |
| | | <ul style="list-style-type: none"> Contact hazards assessed for all project phases within the baseline and residual risk assessments. | Annex B Annex C |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|--|--|---|---------------------|
| | | <ul style="list-style-type: none"> Additional mitigation measure 'Appropriate alignment and spacing of arrays and devices' suggested. | Section 13 |
| | <ul style="list-style-type: none"> Suitable usage of lights and marks should mitigate against contact risk. | <ul style="list-style-type: none"> Mitigation measure 'Marked in accordance with Trinity House' embedded into project. | Section 11.4 |
| | <ul style="list-style-type: none"> SAR is primarily a concern of smaller vessels, however, lines and squares are typically preferable over an 'organic' design for SAR. | <ul style="list-style-type: none"> Additional mitigation measure 'Appropriate alignment and spacing of arrays and devices' suggested. | Section 13 |
| Trinity House (Teleconference 07 August 2020) | <ul style="list-style-type: none"> Surface and surface breaking devices would be expected to be aligned in straight rows ensuring clear lines of sight and to maximise marking and visibility. | <ul style="list-style-type: none"> Additional mitigation measure 'Appropriate alignment and spacing of arrays and devices' suggested. | Section 13 |
| | <ul style="list-style-type: none"> Isolated surface breaking devices requiring marking should not be separated from the primary arrays. Individual structures remote from the development would need to be further risk assessed and considered separately. | <ul style="list-style-type: none"> Additional mitigation measure 'Undertake device / array specific risk assessments to include NavAids and marker buoys' suggested. | Section 13 |
| | <ul style="list-style-type: none"> TH would not be able to comment on marking at this stage. Marking will need to be determined once a device specific | <ul style="list-style-type: none"> Additional mitigation measure 'Undertake device / array specific risk | Section 13 |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|-----------|---|--|----------------------------------|
| | layout is agreed. Sign off on layouts should be carried out in consultation with TH and the MCA. | assessments to include NavAids and marker buoys' suggested. | |
| | <ul style="list-style-type: none"> In cases of areas where devices are not surface piercing there would be a requirement for a surface mark. It may be the case that marking broad areas is more appropriate than the marking of individual devices, however, more information on the device types and layout is required to determine if / where marking would be required. | <ul style="list-style-type: none"> Additional mitigation measure 'Minimise use of marker buoys in zones of minimum UKC' suggested. | Section 13 |
| | | <ul style="list-style-type: none"> Additional mitigation measure 'Undertake device / array specific risk assessments to include NavAids and marker buoys' suggested. | Section 13 |
| | <ul style="list-style-type: none"> TH stated that the preference would be for the site to remain as open for use as possible. | <ul style="list-style-type: none"> Additional mitigation measure 'Restrict Navigation through the Gold and Green MDZ Zones' suggested in baseline assessment. | Annex B Annex C |
| | | <ul style="list-style-type: none"> Effectiveness of suggested additional mitigation measure 'Restrict Navigation through the Gold and Green MDZ Zones' assessed in residual assessment. | Annex B Annex C |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|---|--|--|----------------------------------|
| Maritime and Coastguard Agency (MCA) (Teleconference 07 August 2020) | <ul style="list-style-type: none"> The updated design of the zone of minimum 8m UKC, now following a straighter line, is considered to be an improvement on the previously proposed design. | <ul style="list-style-type: none"> Zone of 8m minimum UKC embedded in project design and risk assessment as an embedded mitigation measure. | Section 11.4 |
| | | <ul style="list-style-type: none"> Effectiveness of introduction of 8m UKC embedded mitigation measure assessed within the baseline risk assessment. | Annex B Annex C |
| | <ul style="list-style-type: none"> Exclusion of fishing has not been requested at other similar OREI sites. This will likely occur by default. As long as up-to-date information is correctly promulgated to stakeholders and the MDZ is marked on navigational charts, fishermen should be aware of the MDZ. | <ul style="list-style-type: none"> Additional mitigation measure 'MDZ designation as No Fishing Zone' suggested in baseline assessment. | Annex B Annex C |
| | | <ul style="list-style-type: none"> Effectiveness of suggested additional mitigation measure 'MDZ designation as No Fishing Zone' assessed in residual assessment. | Annex B Annex C |
| | | <ul style="list-style-type: none"> Mitigation measure 'Promulgation of information concerning MDZ to all mariners including fishermen' embedded into project. | Section 11.4 |
| | | <ul style="list-style-type: none"> Additional mitigation measure 'Restrict Navigation through the Gold and Green | Annex B Annex C |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|-----------|--|--|----------------------------------|
| | <ul style="list-style-type: none"> [With reference to the restriction of navigation] proper charting and marking allowing a prudent mariner to make their own judgement would allow freedom of navigation. | MDZ Zones' suggested in baseline assessment. | |
| | | <ul style="list-style-type: none"> Effectiveness of suggested additional mitigation measure 'Restrict Navigation through the Gold and Green MDZ Zones' assessed in residual assessment. | Annex B Annex C |
| | | <ul style="list-style-type: none"> Mitigation measure 'Surveyed and charted as required by UKHO' embedded into project. | Section 11.4 |
| | <ul style="list-style-type: none"> Proper notifications should be given when installations are taking place. Local notifications including local Notices to Mariners and other appropriate Maritime Safety Information should be issued. International notifications may include; Notice to Mariners, T&Ps, NavArea1, Hydrolants etc. | <ul style="list-style-type: none"> Mitigation measure 'Promulgation of information concerning MDZ to all mariners including fishermen' embedded into project. | Section 11.4 |
| | <ul style="list-style-type: none"> Clarification was given that mitigation measure [for a guard vessel] is recommended for use in the construction phase only. | <ul style="list-style-type: none"> Additional mitigation measure 'Guard vessel to monitor passing traffic' suggested in the construction phase. | Section 13 |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|---|---|---|--|
| Harbour Master (written feedback received on 31 July 2020) | <ul style="list-style-type: none"> Overall port traffic is expected to increase as new port infrastructure is constructed. | <ul style="list-style-type: none"> Future traffic levels are considered in the assessment of navigation risk. | Section 7.7 |
| | <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. | <ul style="list-style-type: none"> Metoccean conditions are considered in the assessment of navigation risk. | Section 4.1 Annex B Annex C |
| | <ul style="list-style-type: none"> Fishing vessel activity [from winter 2017 and summer 2017 surveys] shown in the inshore area is less than expected. | <ul style="list-style-type: none"> Fishing data from AIS and RADAR supplemented with fishing intensity VMS data. | Section 7.3.6 |
| | | <ul style="list-style-type: none"> An additional AIS and RADAR survey undertaken in April 2019. | Section 7.1 Section 7.3.6 |
| | <ul style="list-style-type: none"> Unaware of commercial vessels anchoring in Abrahams Bosom. | <ul style="list-style-type: none"> Snagging / Obstruction identified as a primary hazard for assessment across all vessel and device types. | Section 11.2 |
| | | <ul style="list-style-type: none"> Snagging / Obstruction assessed for all project phases within the baseline and residual risk assessments. | Annex B Annex C |
| | | <ul style="list-style-type: none"> Additional Mitigation measure 'Establish no anchoring areas' suggested. | Section 13 |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|--|--|---|---|
| | <ul style="list-style-type: none"> Hazard of loss of power and being swept/blown on to device should be considered. | <ul style="list-style-type: none"> 'Equipment or Mechanical Failure' identified as a hazard cause and assessed against all relevant hazards. | <p>Annex B Annex C</p> |
| Trearddur Bay Sailing Club (written feedback received on 6 th August 2020) | <ul style="list-style-type: none"> We can see little material improvement over the previous scheme and still have grave concerns over the impact on yachting. | <ul style="list-style-type: none"> Impact to recreational vessels assessed for all identified hazard types. | <p>Annex B Annex C</p> |
| | <ul style="list-style-type: none"> We still feel that any surface mounted or surface piercing devices present an unacceptable risk to shipping and yachting at this point on the coast. In broad terms we would support the whole scheme, were the Developer to commit to a purely under water array. | <ul style="list-style-type: none"> Navigational risk arising from the presence of surface piercing devices within the gold and green MDZ zones assessed for all vessel types. | <p>Annex B Annex C</p> |
| | <ul style="list-style-type: none"> We still feel that the navigable corridor between the proposed area and South Stack is far too narrow. | <ul style="list-style-type: none"> Zone of 8m minimum UKC embedded in project design and risk assessment as an embedded mitigation measure. Navigation risk across the MDZ and inshore passage assessed for all vessel types. | <p>Section 11.4</p> <p>Annex B Annex C</p> |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|-----------|--|---|---|
| | <ul style="list-style-type: none"> [The navigable corridor] presents a very dangerous 'lee-shore' risk, with the prevailing south westerlies to the treacherous shoreline of South Stack, Abrahams Bosom and it should be remembered that there is a complex series of back-eddies (the 'seven tides') that make sailing by Abrahams Bosom very tricky. | <ul style="list-style-type: none"> Inherent met-ocean conditions identified and assessed as a cause across all assessed hazards. | <p>Annex B</p> <p>Annex C</p> |
| | <ul style="list-style-type: none"> We really fear a risk to life if this whole stretch becomes only a narrow navigable corridor. | <ul style="list-style-type: none"> Zone of 8m minimum UKC embedded in project design and risk assessment as an embedded mitigation measure. | Section 11.4 |
| | | <ul style="list-style-type: none"> The potential risk of loss of life as a consequence of navigational hazards assessed across all hazard types. | <p>Annex B</p> <p>Annex C</p> |
| | <ul style="list-style-type: none"> We support the RYA position that it is unacceptable to define the scheme as a test area, where no pre-approval of technology is necessary and whereby any impact assessments are rendered theoretical by the lack of commitment to turbine type. | <ul style="list-style-type: none"> The NRA assesses the installation of any of the proposed device types in any location (worst credible) in adherence with the zones of minimum UKC embedded into the project design. | Section 1 |
| | | <ul style="list-style-type: none"> Additional mitigation measure 'Undertake Device / Array Specific Risk | Section 13 |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|--|---|---|---|
| | | Assessments to include NavAids and Marker Buoys' suggested. | |
| Irish Ferries (written feedback received on 14 th August 2020) Stena Line (written feedback received on 01 September 2020) | <ul style="list-style-type: none"> The 20m UKC is of great benefit and assuages most of our concerns. | <ul style="list-style-type: none"> Zone of 20m minimum UKC embedded in project design and risk assessment as an embedded mitigation measure. | Section 11.4 |
| | <ul style="list-style-type: none"> The proposed development will prevent the use of certain routes that are only used rarely in particular circumstances, and we can accept this. | <ul style="list-style-type: none"> Baseline vessel traffic profile, including poor weather routeing assessed. | Section 7.3.3 |
| | <ul style="list-style-type: none"> The proposed development will still restrict options for ferries that cannot enter the Port of Holyhead in inclement weather – i.e. it limits areas in which to shelter. | <ul style="list-style-type: none"> 'Running for shelter / safe haven in poor weather' identified as a causal factor in risk assessment. | Annex B Annex C |
| | <ul style="list-style-type: none"> The proposed development leads to less sea room for traffic going in and out of Holyhead to safely pass each other. Inbound/Eastbound traffic may tend to navigate further north than it does presently, with the result that outbound/westbound traffic will be pushed further north, with the risk of impinging on the Traffic Separation Scheme. | <ul style="list-style-type: none"> Collision identified as a primary hazard for assessment across all vessel and device types. Collision hazards assessed for all project phases within the baseline and residual risk assessments. | Section 11.2 Annex B Annex C |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|--|--|---|--|
| | <ul style="list-style-type: none"> Northbound Traffic bound for the TSS may be less inclined to alter to starboard (towards the development) to give way to outbound/westbound traffic from Holyhead. | <ul style="list-style-type: none"> Collision identified as a primary hazard for assessment across all vessel and device types. | Section 11.2 |
| | | <ul style="list-style-type: none"> Collision hazards assessed for all project phases within the baseline and residual risk assessments. | Annex B Annex C |
| Snowdonia Canoe Club (written response received on 16 th August 20) Canoe Wales | <ul style="list-style-type: none"> The zonation of the MDZ should not itself impede passage around the Stacks by kayak. | - | - |
| | <ul style="list-style-type: none"> We are concerned that changes to the hydrodynamics of the inshore passage may render it unsafe for existing use. | <ul style="list-style-type: none"> Changes to met-ocean conditions and hydrodynamics identified and assessed as a causal factor for powered and un-powered recreational vessels. | Section 9 Annex B Annex C |
| | <ul style="list-style-type: none"> We are concerned that floating and emergent structures within the MDZ are a significant hazard and pose a risk to life. | <ul style="list-style-type: none"> Navigational risk arising from the presence of surface piercing devices within the gold and green MDZ zones assessed for all vessel types. | Annex B Annex C |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|---|--|--|---|
| (written response received on 17 th August 20, joint response) | | <ul style="list-style-type: none"> The potential risk of loss of life as a consequence of navigational hazards assessed across all hazard types. | Annex B Annex C |
| | <ul style="list-style-type: none"> We are concerned that exclusion zones during construction may restrict passage. | <ul style="list-style-type: none"> Additional mitigation measure 'Implementation of Safety Zones' of appropriate configuration and extent suggested. Configuration and extent as directed by the regulator. | Section 13 |
| | <ul style="list-style-type: none"> The navigation risk for kayaks between the coast and MDZ are likely to be intolerable. | <ul style="list-style-type: none"> Navigation risk to un-powered recreational vessels assessed for all identified hazard and device types. | Section 11.2 Annex B Annex C |
| | <ul style="list-style-type: none"> The changes indicated in the Wallingford model suggest increases in flow speed of up to 0.8 m/sec and up to 0.5 m to wave heights. This alone would prevent passage by a significant proportion of paddlers. | <ul style="list-style-type: none"> The increased flow speeds of up to 0.8 m/sec and wave heights up to 0.5 m are modelled on Force 6 or greater conditions. | Section 9.1 |
| | <ul style="list-style-type: none"> Navigational risk will be significantly increased in the whole of the area within and landward of the MDZ and perhaps further afield e.g. Carmel Head and the Skerries. | <ul style="list-style-type: none"> Navigational risk resulting from the presence of MDZ assessed for all vessel types. | Annex B Annex C |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|-----------|--|--|---|
| | <ul style="list-style-type: none"> Once we stop paddling, say for example, to put someone back in their boat after a capsize we are at the mercy of the tide and will be rapidly swept into the MDZ. | <ul style="list-style-type: none"> Risk to life as a result of person in water considered within risk assessment. | Annex B Annex C |
| | | <ul style="list-style-type: none"> Vessel drift and impact of tides reviewed. | Section 9 |
| | | <ul style="list-style-type: none"> 'Set on to device by tidal stream/ pinning' identified as a causal factor for un-powered recreational vessels. | Annex B Annex C |
| | <ul style="list-style-type: none"> [In the case of being swept into the MDZ] we would be very vulnerable to collision and/or entanglement as in a rescue situation we are unable to manoeuvre, will be trailing tow ropes and may have swimmers in the water. | <ul style="list-style-type: none"> Contact identified as a primary hazard for assessment across all vessel and device types. | Section 11.2 Annex B Annex C |
| | | <ul style="list-style-type: none"> 'Set on to device by tidal stream/ pinning' identified as a causal factor for un-powered recreational vessels. | Annex B Annex C |
| | <ul style="list-style-type: none"> Ideally risk control measures would take the form of a safe runout of, say, ten minutes at peak flow 'downstream' of features such as Penrhyn Mawr on the flood and North Stack on the ebb. | <ul style="list-style-type: none"> Zone of 8m minimum UKC embedded in project design and risk assessment as an embedded mitigation measure. | Section 11.4 |
| | | <ul style="list-style-type: none"> Met-Ocean impacts identified and discussed. | Section 9 |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|-----------|---|---|----------------------------------|
| | | <ul style="list-style-type: none"> Inherent met-ocean conditions identified and assessed as a cause across all assessed hazards. | Annex B Annex C |
| | | <ul style="list-style-type: none"> Additional mitigation measure 'Provision of life saving equipment on fixed structures and floating devices' suggested. | Section 11.2 |
| | <ul style="list-style-type: none"> Grab chains and ladders will render the structures more hazardous because of entanglement, the inability of a swimmer to hold on against the tide and likely extreme difficulty of undertaking a rescue close to the floating structure. | <ul style="list-style-type: none"> Effectiveness of suggested additional mitigation measure 'Provision of life saving equipment on fixed structures and floating devices' assessed in residual assessment. | Annex B Annex C |
| | <ul style="list-style-type: none"> We are concerned about the risks posed to kayaks of sharing the inshore passage with construction and other recreational vessels as at present we encounter few other vessels at most a handful of low speed small commercial and recreational fishing boats and occasional dive boats. | <ul style="list-style-type: none"> Baseline vessel traffic profile assessed. | Section 7.2 |
| | | <ul style="list-style-type: none"> Construction phase assessed independently of operational phase to reflect potential increase in traffic as a result of the presence of construction vessels. | Annex B |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|---|--|---|----------------------------------|
| | | <ul style="list-style-type: none"> Collision hazards assessed for all project phases within the baseline and residual risk assessments. | Annex B Annex C |
| Royal Yachting Association (RYA) (email 03 rd September 2020) | <ul style="list-style-type: none"> Given the consultation responses to you from our members, our previous meetings with Morlais/ Menter Mon in 2018 and 2020, our objections to the project – together with the recently supplied RYA Coastal Atlas: the RYA has now provided all relevant information. | - | |
| | <ul style="list-style-type: none"> The changes made to the Eastern boundary do not substantially alter our view on navigational risk, as these changes do not meet the safety requirements identified in our previous meetings with the Morlais project. | <ul style="list-style-type: none"> Zone of 8m minimum UKC embedded in project design and risk assessment as an embedded mitigation measure. | Section 11.4 |
| | | <ul style="list-style-type: none"> Effectiveness of introduction of 8m UKC embedded mitigation measure assessed within the baseline risk assessment. | Annex B Annex C |
| | | <ul style="list-style-type: none"> Navigational risk resulting from the presence of MDZ assessed for all vessel types. | Annex B Annex C |
| Royal National Lifeboat | <ul style="list-style-type: none"> No response received | - | - |

| Consultee | Key Shipping and Navigation Comments / Navigation Concerns | NRA Response | NRA Reference |
|-------------------------------------|--|--------------|---------------|
| Institution (RNLI) | | | |
| Welsh Fisherman's Association | <ul style="list-style-type: none"> No response received | - | - |
| Anglesey Watersport | <ul style="list-style-type: none"> No response received | - | - |
| Anglesey School of Yachting | <ul style="list-style-type: none"> No response received | - | - |

7 VESSEL TRAFFIC ANALYSIS

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

7.1 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 MDZ relative to areas used by any type of marine craft;
- Numbers, types and sizes of vessels presently using the MDZ 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.

7.1.1 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).

7.1.2 AIS Limitations

It should be noted that there are limitations with AIS data. Class B transponders, of comparatively reduced range, are often used by recreational vessels however, are not mandatory, therefore many small leisure and fishing vessels are not be equipped with AIS transmitters at all with vessels under 10 m less likely to carry AIS equipment than those over 10 m. Additionally, if power saving is a concern, transponders may not be switched on.

While class A AIS is mandatory on most larger vessels, military or government vessels not wishing to reveal their locations may switch transmitters off.

7.1.3 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 sets out the requirement for radar data collection in MGN 543 which 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).

7.1.4 Recording Periods

The data collected for utilisation within the Navigation Risk Assessment is summarised within **Table 7-1**.

Table 7-1: 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 ⁸ |

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. This survey was therefore superseded.

⁸ 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.

7.2 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 in **Figure 2**. 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 MDZ utilised by Irish Ferries and Stena Line (see **Figure 6**).

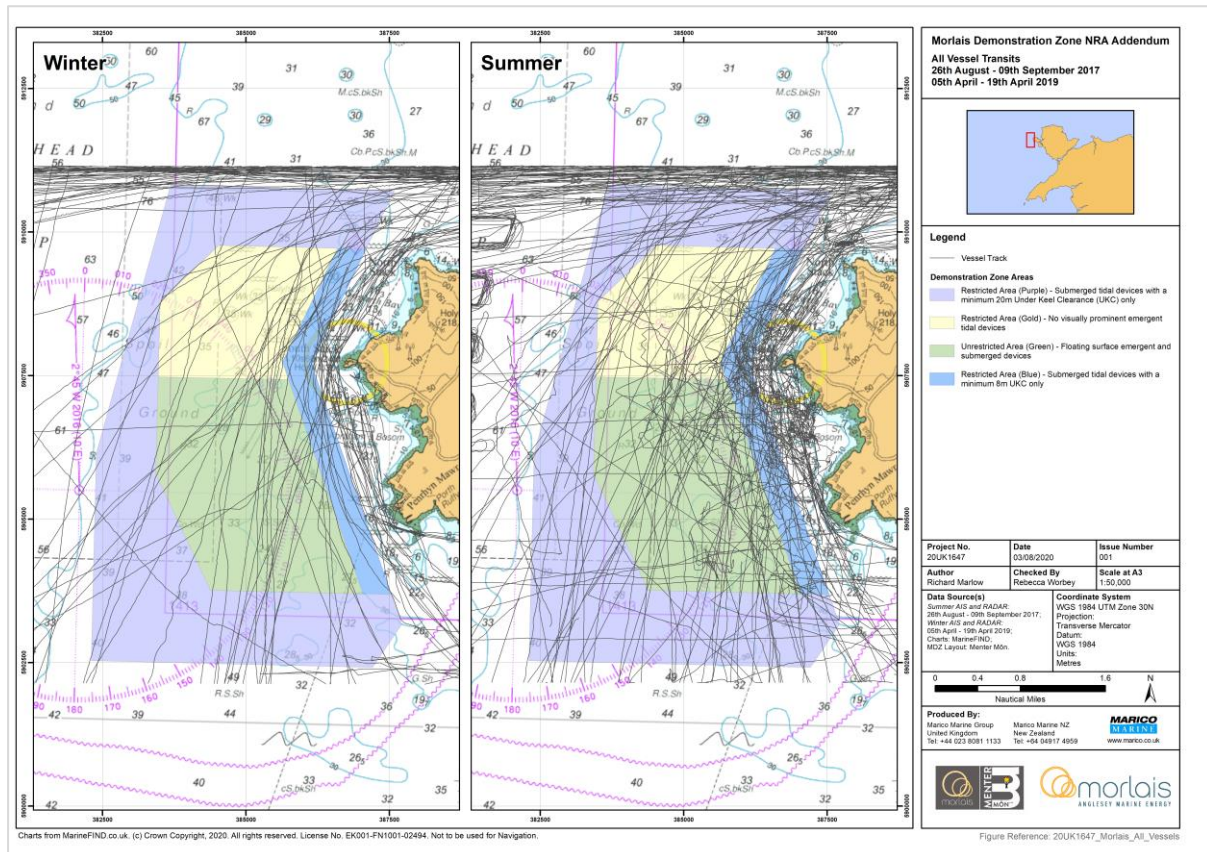


Figure 2: Vessel tracks - summer 2017 and winter 2019.

7.3 ANALYSIS BY VESSEL TYPE

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

7.3.1 Vessel Classification

Following assessment of the primary vessel types present within the area, vessel types were grouped in to the categories outlined in **Table 7-2** for analysis and assessment within the NRA.

Table 7-2: Vessel Categories

| Ref | Vessel Type Category | Draught | Including |
|-----|--------------------------------|---------|---|
| 1 | Commercial Vessel | >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 | Project Vessels | >3m | Cable laying vessels, barges and heavy lift vessels. |
| 3 | Fishing Vessel | <3m | Fishing Vessels |
| 4 | Powered Recreational Vessel | <3m | Yachts, power boats, recreational RIBs, Recreational fishing boats. |
| 5 | Un-Powered Recreational Vessel | <3m | Sailing dinghies, kayaks, canoes, rowing boats, SUPs. |
| 6 | Other Vessel | <3m | Tugs and tows, survey vessels, RNLI, construction and maintenance vessels, cable laying vessels, workboats, commercial RIBs. |

7.3.2 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 3**.

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 MDZ. There were two vessels of this category within the summer dataset; the Trinity House vessel *Patricia* (draught 4.5m) and the dredger *DEO Gloria* (draught 3.3m). No tankers were recorded within either dataset.

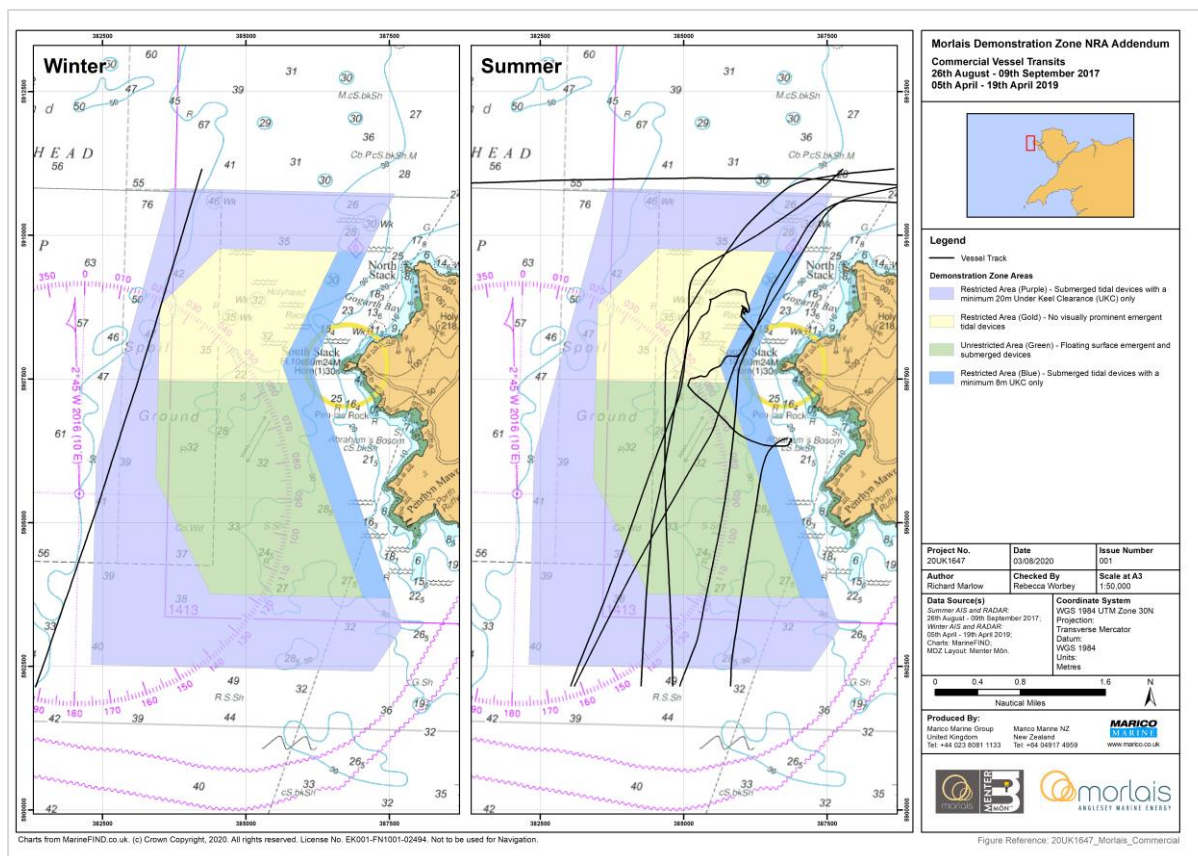


Figure 3: Commercial vessel tracks - summer 2017 and winter 2019

7.3.3 Passenger Vessels

Irish Ferries and Stena Line ferries operate to the north of the proposed MDZ as shown in **Figure 5** and **Figure 6**. Typically, the ferries generally 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 7-3** and **Figure 4**.

Table 7-3: Consultation feedback in relation to poor weather routing

| Consultee | Feedback |
|-------------------------------|--|
| 2019 NRA Stakeholder 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 MDZ. 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 MDZs 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. |
| NRA Addendum Stakeholder Feedback | |
| Chamber of Shipping | <ul style="list-style-type: none"> • In terms of poor weather routeing; the changes introduced represent a pretty good compromise in terms of navigation safety. |
| Irish Ferries and Stena Line | <ul style="list-style-type: none"> • The proposed development will prevent the use of certain routes that are only used rarely in particular circumstances, and we can accept this. |

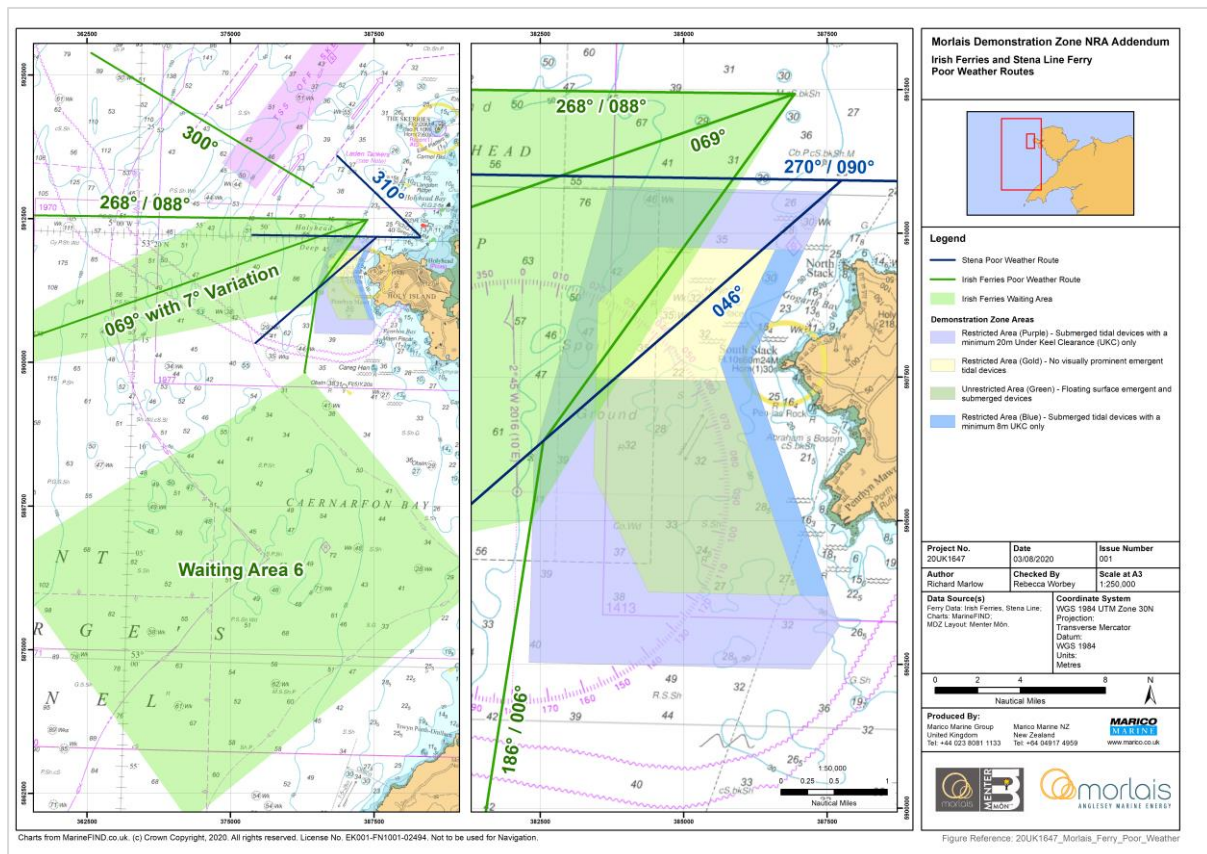


Figure 4: Irish Ferries and Stena Line –Indicative Poor Weather Routes from 2019 NRA Consultation

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 6** transiting through the proposed MDZ to anchor at Abrahams Bosom on 03rd March 2018 during the ‘beast from the east’ storm. Although this is considered a rare event (see **Table 7-3**), alternative poor weather/ emergency anchor routes would likely need to be established, should devices with an UKC of <20m be deployed within the MDZ.

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 MDZ and are present within all nine sub-zones. Cruise ships undertake thorough passage planning and, in contrast to ferries and therefore, may more easily alter passage plans to accommodate offshore infrastructure.

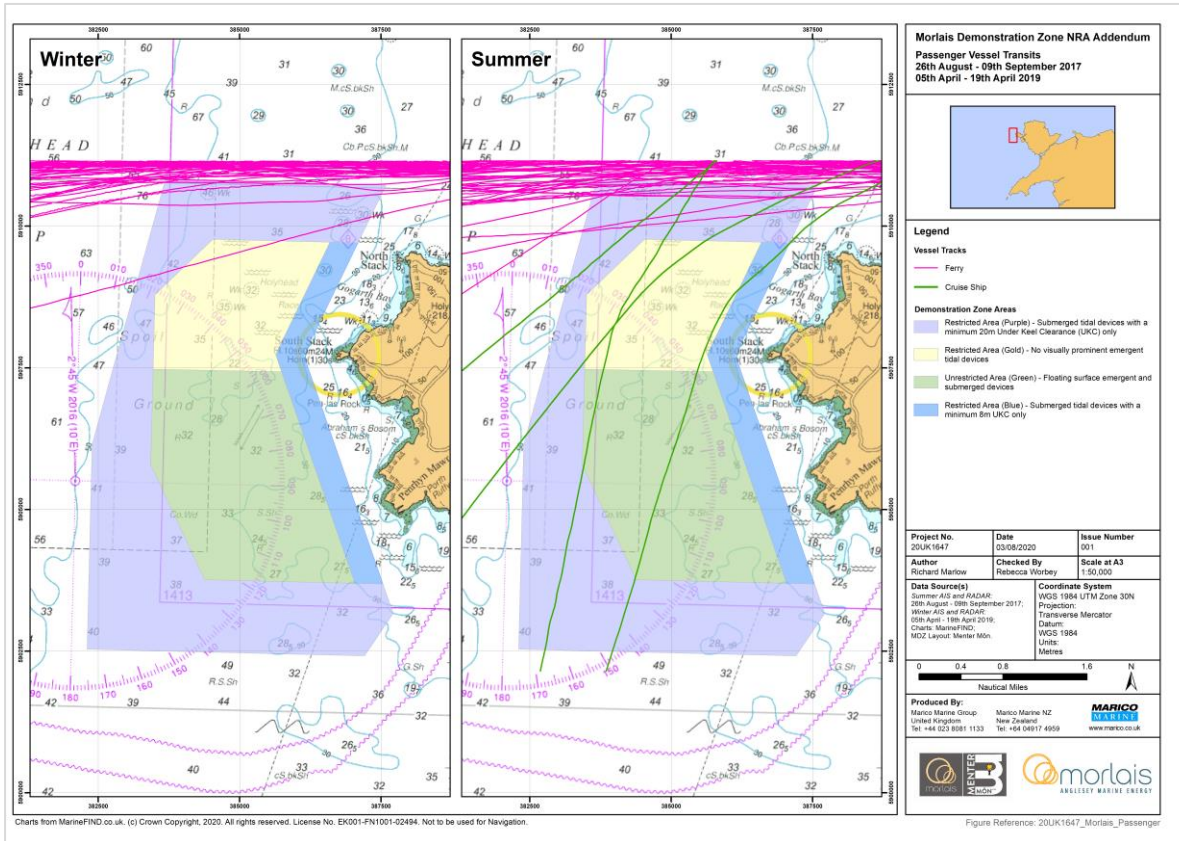


Figure 5: Passenger vessel transits –summer 2017 and winter 2019

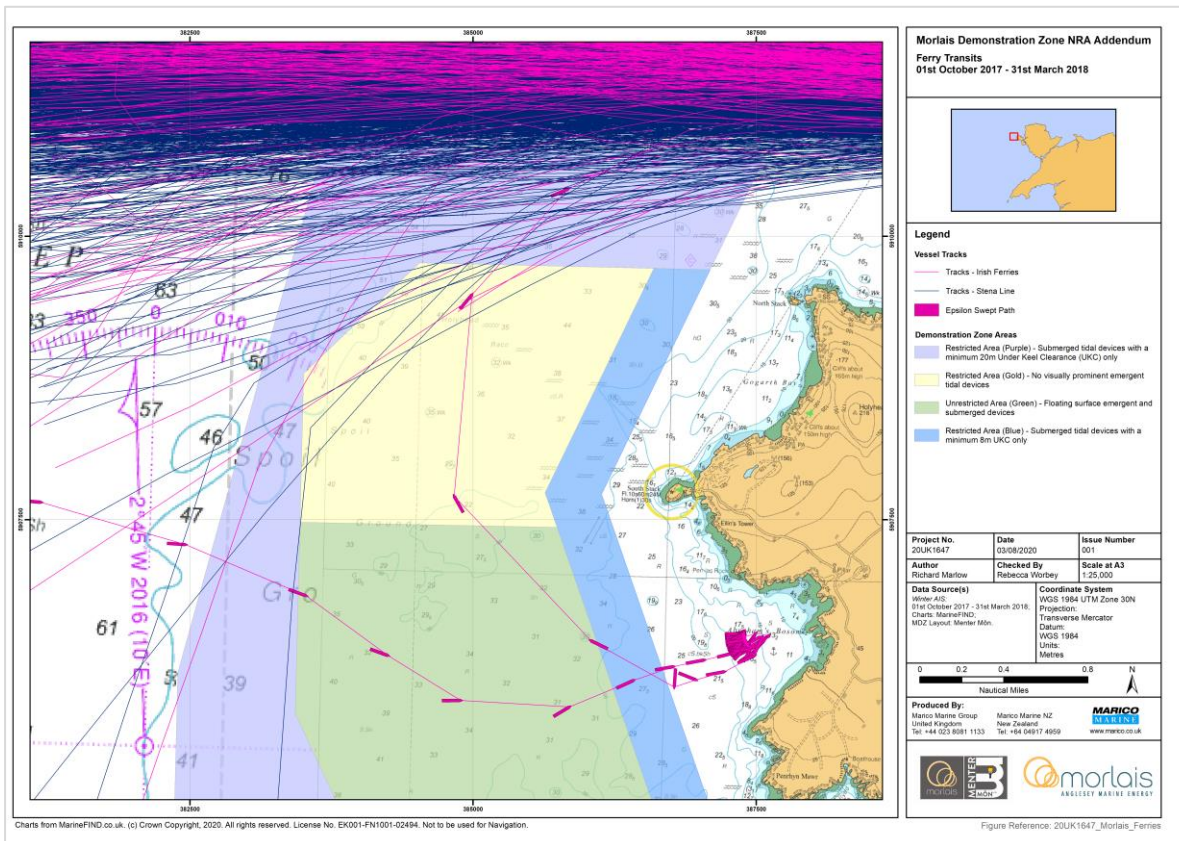


Figure 6: Ferry transits - 01st October 2017 to 31st March 2018

7.3.4 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 7** 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 MDZ within the winter dataset. One transit by *Smit Don* was recorded within the northern most sub-zone of the proposed MDZ within summer. *Smit Don* has a recorded draught of <3m.

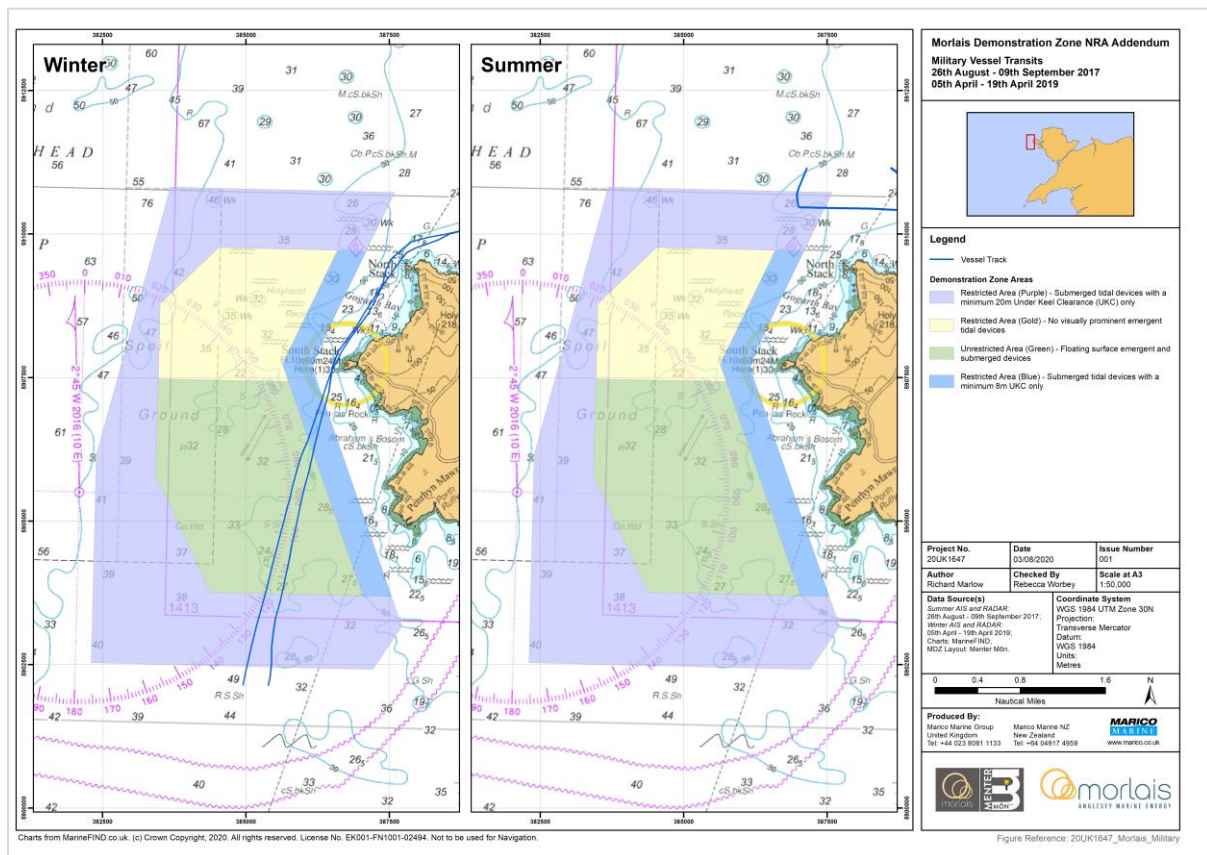


Figure 7: Naval vessel tracks - summer 2017 and winter 2019

7.3.5 Other Vessels

Figure 8 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 MDZ 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.

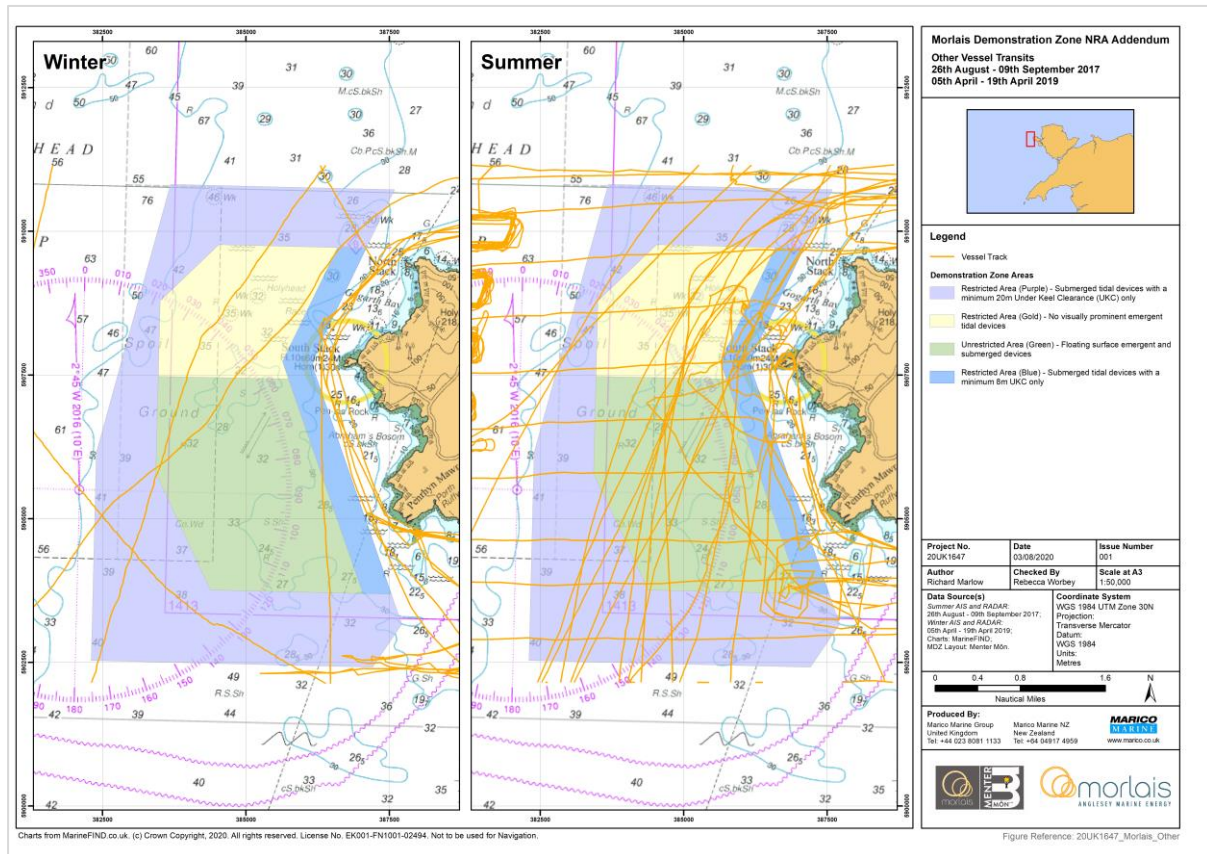


Figure 8: Other vessel tracks - summer 2017 and winter 2019

7.3.6 Fishing Vessels

Holyhead is one of three main commercial fishing ports in Wales. Catch types within the vicinity of the MDZ 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 9**. The ASD⁹ 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 MDZ are comprised of smaller fishing vessels that do not carry AIS while the majority of fishing vessels on transit are larger

⁹ 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.

AIS carrying vessels. It is noted that vessels engaged in fishing are more prevalent within summer than winter where the majority of vessels are on transit through the MDZ.

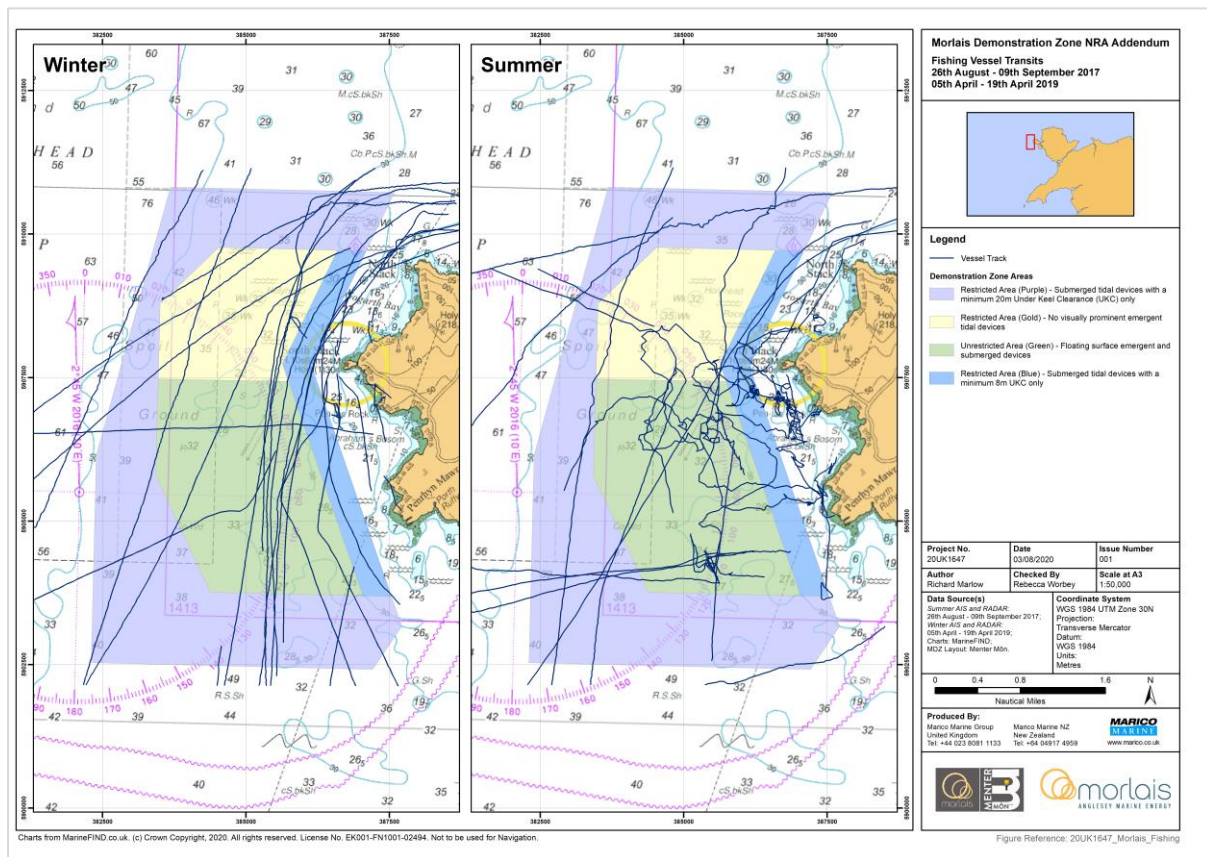


Figure 9: Fishing vessel tracks - summer 2017 and winter 2019

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 MDZ is shown within **Figure 10**. 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.

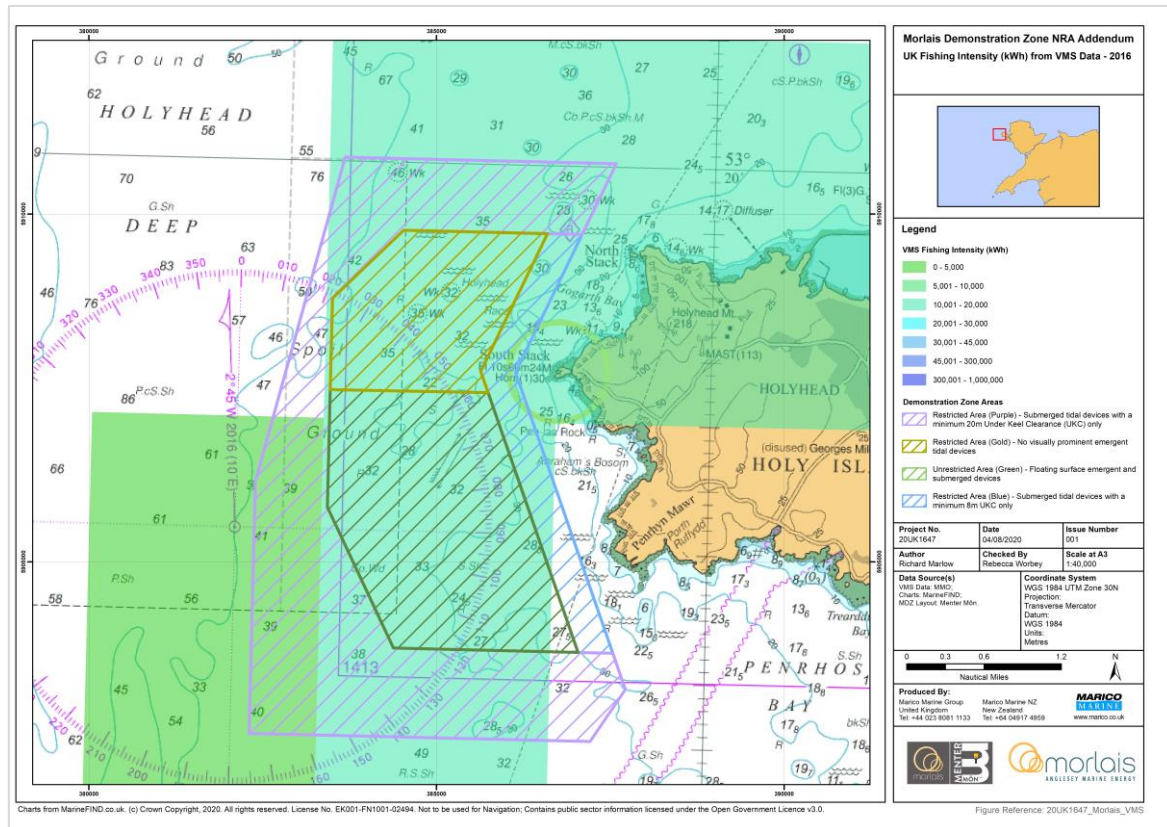


Figure 10: Fishing intensity (kWh) from VMS data - 2016

7.3.7 Recreational Vessels

The tracks of recreational vessels are given within **Figure 11**. Most tracks are concentrated close to shore with small recreational craft, including yachts, primarily utilising the inshore passage to the east of the MDZ. The density of recreational vessels increases substantially in summer, as demonstrated by

Table 7-4, where the area occupied by these vessels is much greater, overlapping the eastern portion of the proposed MDZ, 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. The increase in activities in August were reported to be mainly confined to the inshore waters between Holyhead and Trearddur Bay/Penrhos Bay. This additional activity has been taken into account within the scoring of navigational risk within the risk assessment contained within **Annex B** and **Annex C**. Local recreational stakeholders, however, did note that ‘the vessel traffic pattern represented within analysis looks correct’.

The presence of a western route was noted by local recreational stakeholders and the RYA in consultation. It was reported by local recreational stakeholders (**Annex E**) that ‘tracks transiting SW / NE through site are from Bardsey Island and Cork’ and by the RYA that ‘members indicate that the Western Offshore route is normally used as part of passage planning from Liverpool and Holyhead to Bardsey Bay¹⁰ Recreational vessels are noted in **Figure 11** transiting NE/SW through the MDZ, however, by comparison to the inshore route, vessel transit density in the western route is noted to be low. This is in-keeping with the feedback obtained during consultation with local recreational representatives that ‘usage of this route is limited in comparison to the inshore route. The primary concern is the restriction of the inshore passage which is essential to recreational vessels’ (**Annex E**).

Table 7-4: Recreational Vessel Transits from RADAR and AIS – Summer and Winter Surveys

| Data Type | Season | Duration | Time Period | Recreation/Sailing Vessel Count | Average count per day |
|-----------|--------|----------|--|---------------------------------|-----------------------|
| AIS | Summer | 2 weeks | 26th August - 09th September 2017 | 33 | 2 |
| RADAR | Summer | 2 weeks | 26th August - 09th September 2017 | 83 | 6 |
| AIS | Winter | 2 weeks | 05th April - 19th April 2019 | 21 | 2 |
| RADAR | Winter | 2 weeks | 05 th April - 19th April 2019 | 38 | 3 |

¹⁰ FEI - OBJ013 (2020) Transport and Works Act (TWA) order application TWA/3234121

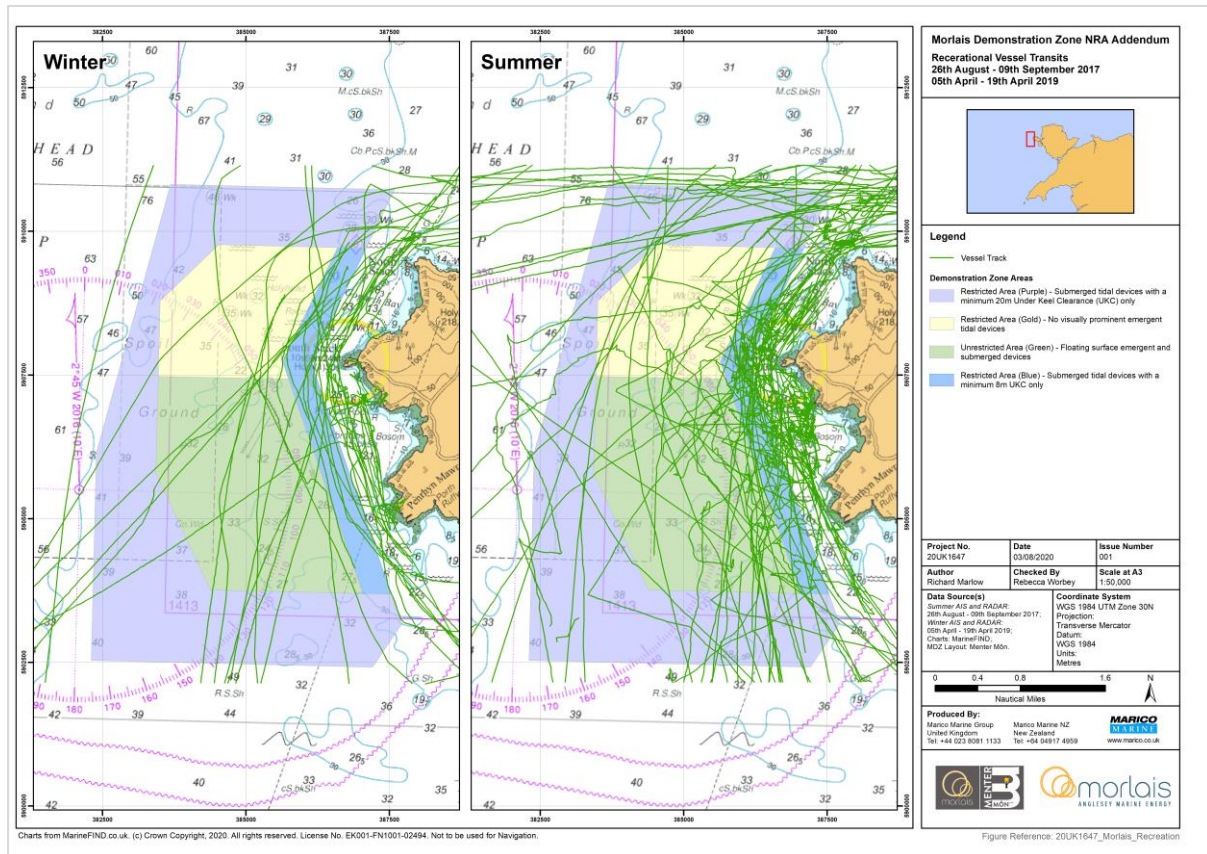


Figure 11: Recreational vessel tracks - summer 2017 and winter 2019

Activities of small un-powered recreational craft such as kayaks, canoes and small dinghies, similarly to sailing vessels, were reported in consultation to operate primarily close inshore within the inshore passage; *'the zonation of the MDZ as indicated in **Figure 1** should not itself impede passage around the Stacks by kayak' (Annex D)*. This is further corroborated by **Figure 12** which demonstrates kayak transits within the inshore route and close to shore.

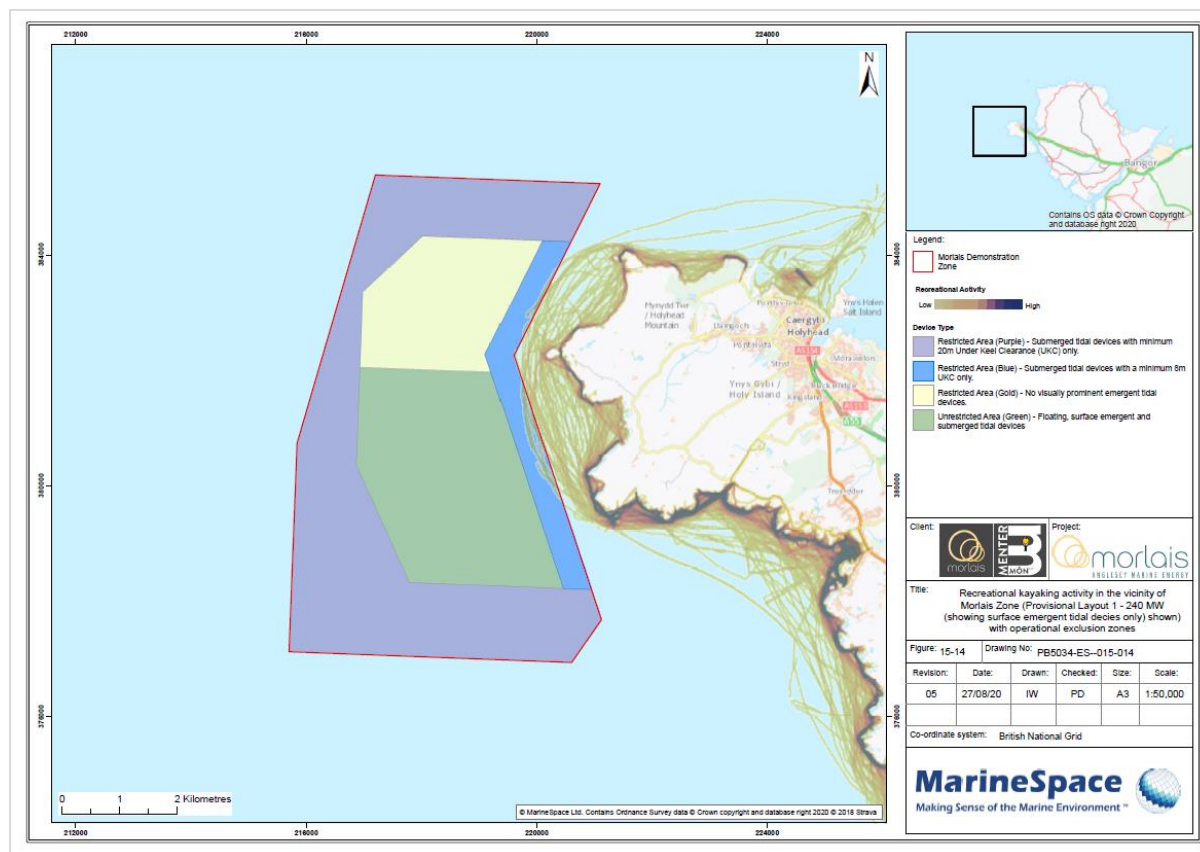


Figure 12: Sea Kayaking in vicinity of MDZ – Source: Marine Space

7.3.8 RYA UK Coastal Atlas of Recreational Boating

The RYA UK Coastal Atlas of Recreational Boating (CA) provides relative AIS intensity data, general boating areas, and locations of clubs and training centres. The CA utilises AIS data from the summers of 2014 and 2017, to indicate the intensity of boating activity per 0.25 km x 0.25 km unit area in coastal waters around the UK¹¹. The mean values of the total count of AIS intersections over the two summer periods are utilised with zero values eliminated. A log10 is then taken of the relative density counts to give an ‘intensity of use’ to prevent high-use areas, such as the Solent, from masking the density outputs of other regions and to accurately portray the routes utilised by recreational vessels. The difference between the original and log10 scenarios is demonstrated in **Annex F**.

It is noted that the dataset is limited in that it only represents vessels that carry AIS transponders, which may exclude a large proportion of small un-powered recreational craft; *‘it is assumed that areas*

¹¹ RYA UK Coastal Atlas of Recreational Boating 2.1 User Guide

close inshore and in many estuaries are frequented by vessels that are small¹². General boating polygon areas are provided to compliment the AIS data. These polygons were generated utilising racing information from the RYA's previous dataset and information acquired from clubs and other sources in 2015 (see **Annex F**) replacing the 2012 dataset that 'cover large expanses of the coastline, and give less information than the AIS data as they indicate no intensity of use¹³ (**Figure 13**).

By comparison to the general boating areas indicated in **Figure 13**, those shown in **Annex F** coincide with the views expressed during stakeholder consultation and corroborates the determination from AIS, RADAR and local stakeholder consultation and the CA AIS data that utilisation of the western route is limited in comparison to that of the inshore areas.

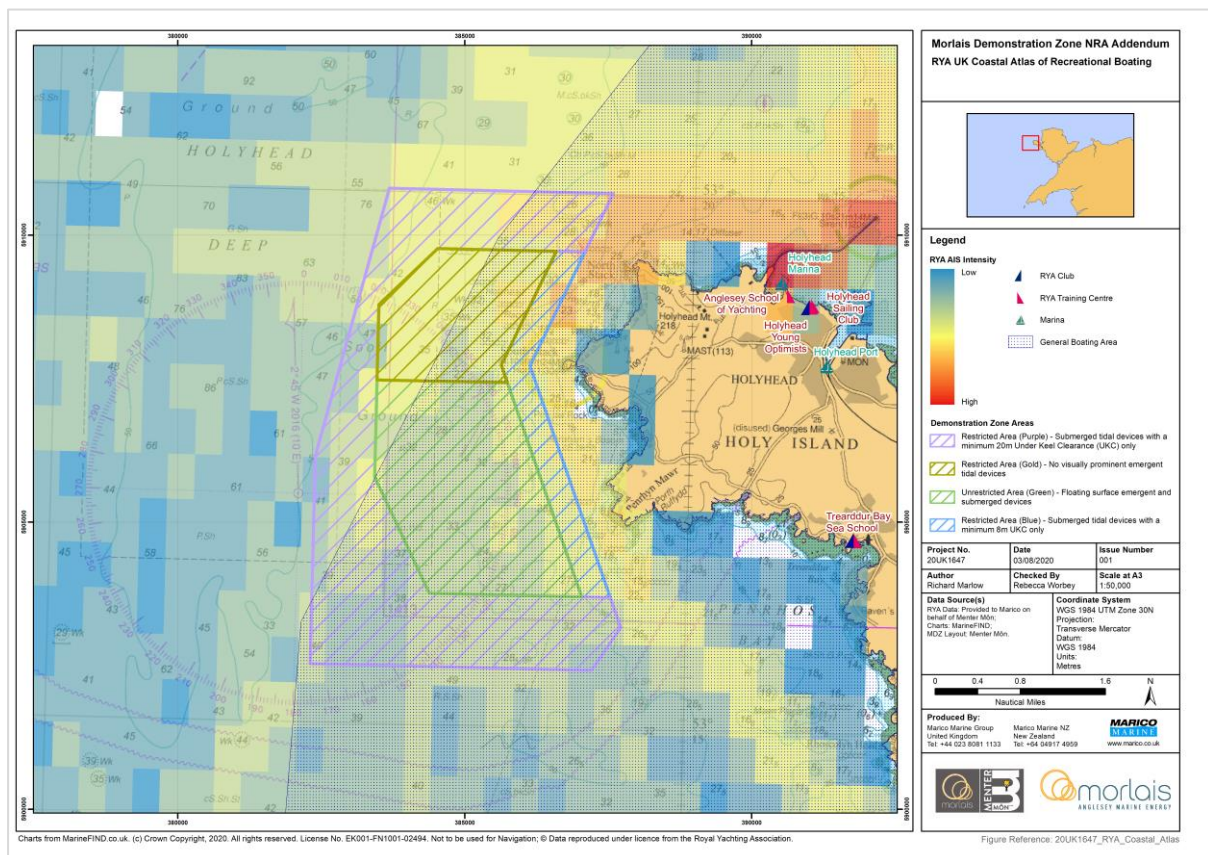


Figure 13: RYA Coastal Atlas of Recreational Boating – AIS mean of summer 2014 and summer 2017.

© Data reproduced under licence from the Royal Yachting Association.

¹² RYA UK Coastal Atlas of Recreational Boating 2.1 User Guide

¹³ RYA UK Coastal Atlas of Recreational Boating 2.1 User Guide

7.4 ANALYSIS BY VESSEL LENGTH

Vessel transits by LOA from AIS between 01st October 2017 and 31st March 2018 are shown in **Figure 14**. The majority of vessels transiting through the MDZ are <21m LOA corresponding to; recreational, fishing and other vessel categories. All vessels transiting through the MDZ with a LOA >167m transited within the north and the western of the MDZ with the exception of *Epsilon* (see **Figure 6**) which transited through the MDZ to anchor at Abrahams Bosom on 03rd March 2018.

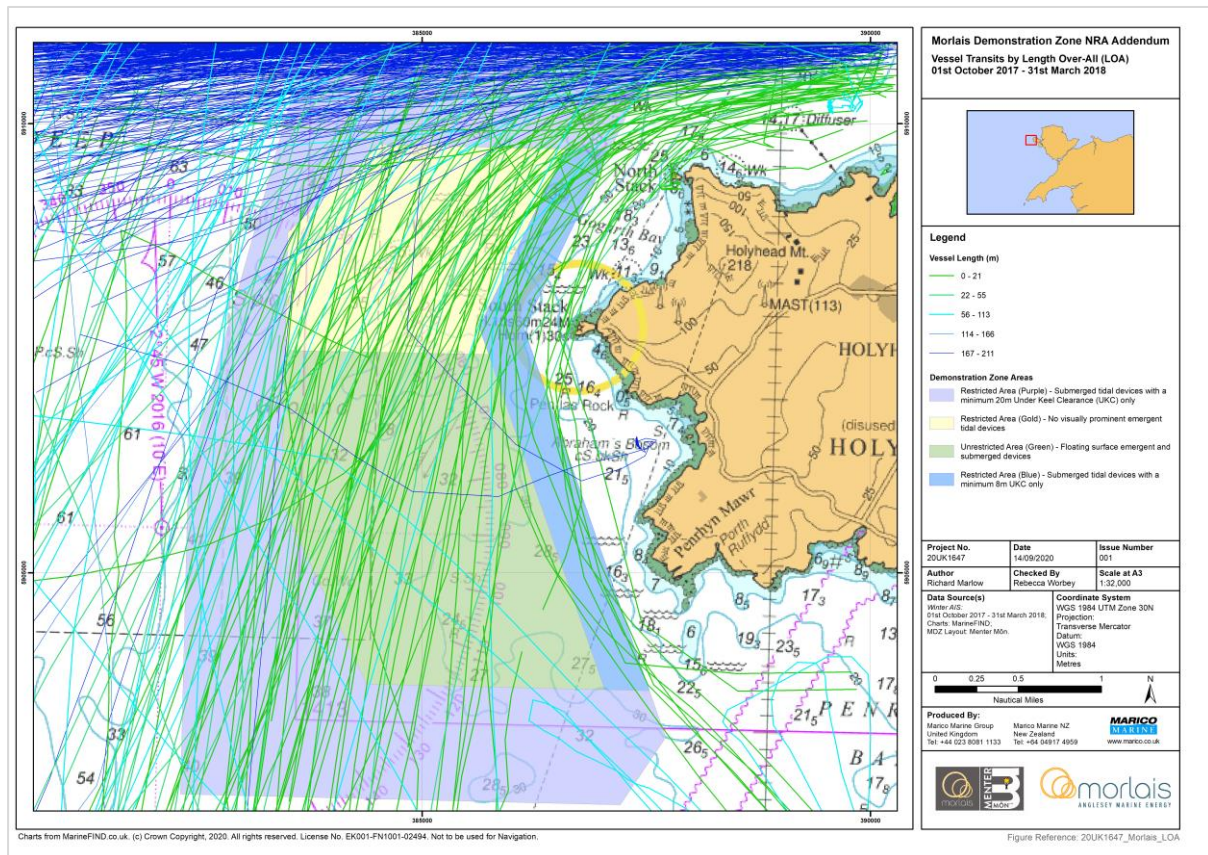


Figure 14: Vessel tracks by LOA (AIS Only) - 01st October 2017 to 31st March 2018

7.5 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 15**. The inshore passage and ferry route to the north of the MDZ are clearly evident, demonstrating the highest traffic densities.

Vessel transit density per month across the MDZ for the winter 2017 / 2018 period (from AIS only) is depicted in **Figure 16**. It is evident that traffic density of larger vessels carrying AIS is low within the MDZ during winter at <4 transits per month, with up to 12 transits per month occurring in the northern most 200m of the MDZ as a result of the ferry route.

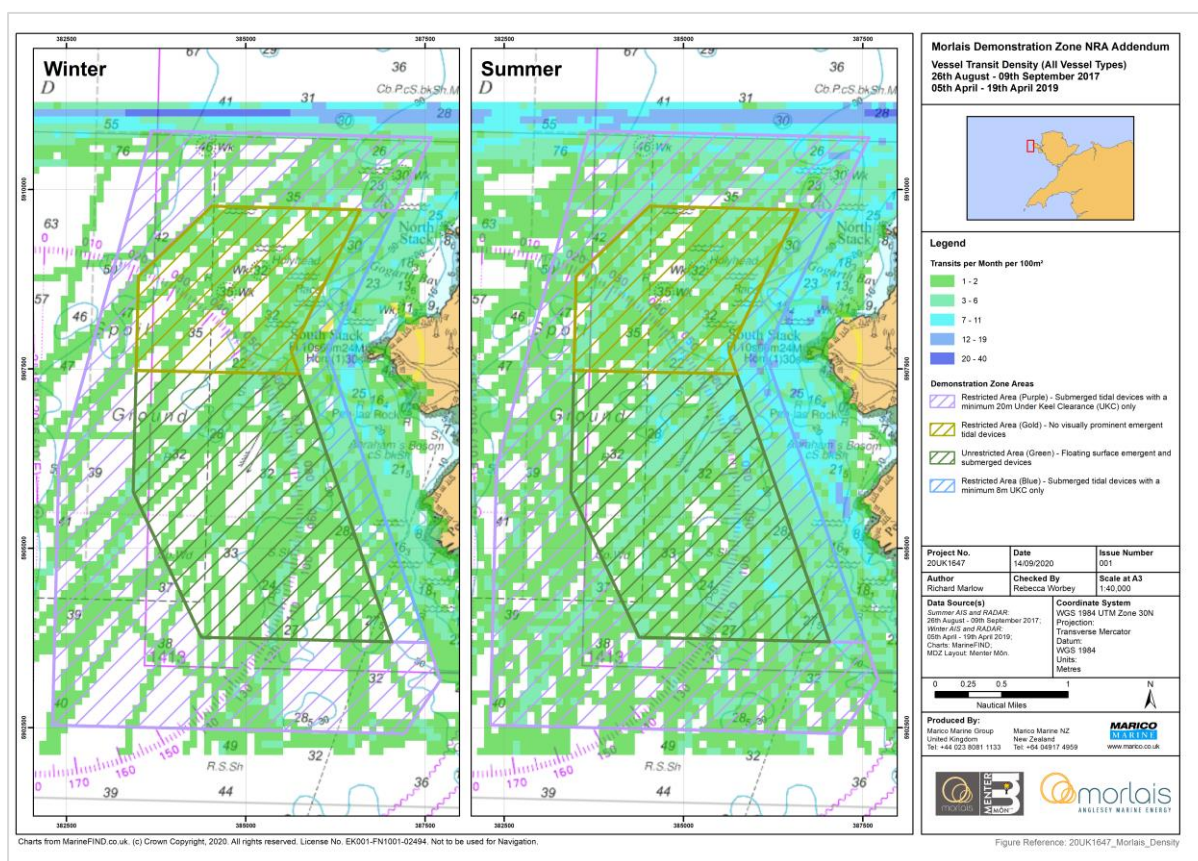


Figure 15: Density – All Vessels (Summer 2017 and Winter 2019) AIS & RADAR

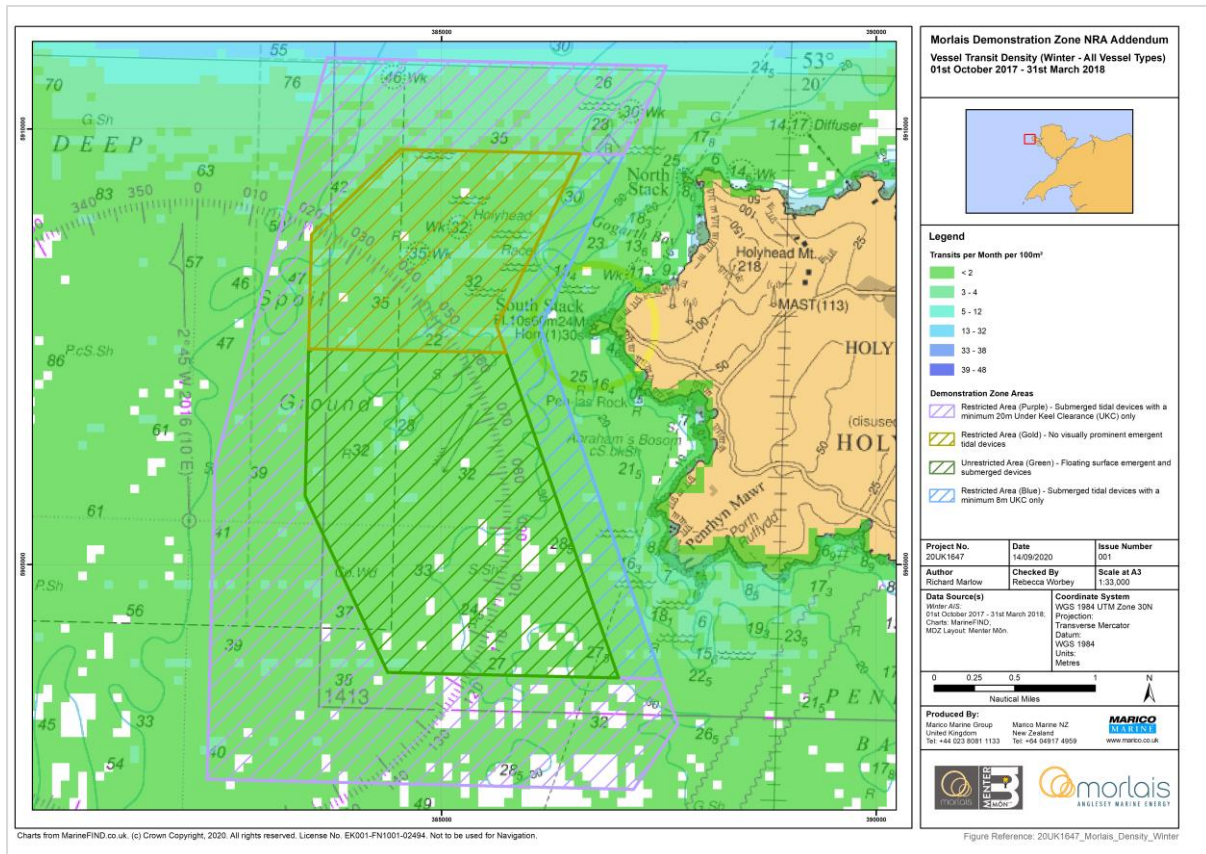


Figure 16: Density – All Vessels (01st October 2017 – 31st March 2018) AIS only.

7.6 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 MDZ from South Stack as depicted within **Figure 17**.

In total 108 transits occurred through the gate. These transits have been analysed according to type in **Figure 18**. The most common vessel type to transit the gate was recreational, 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.

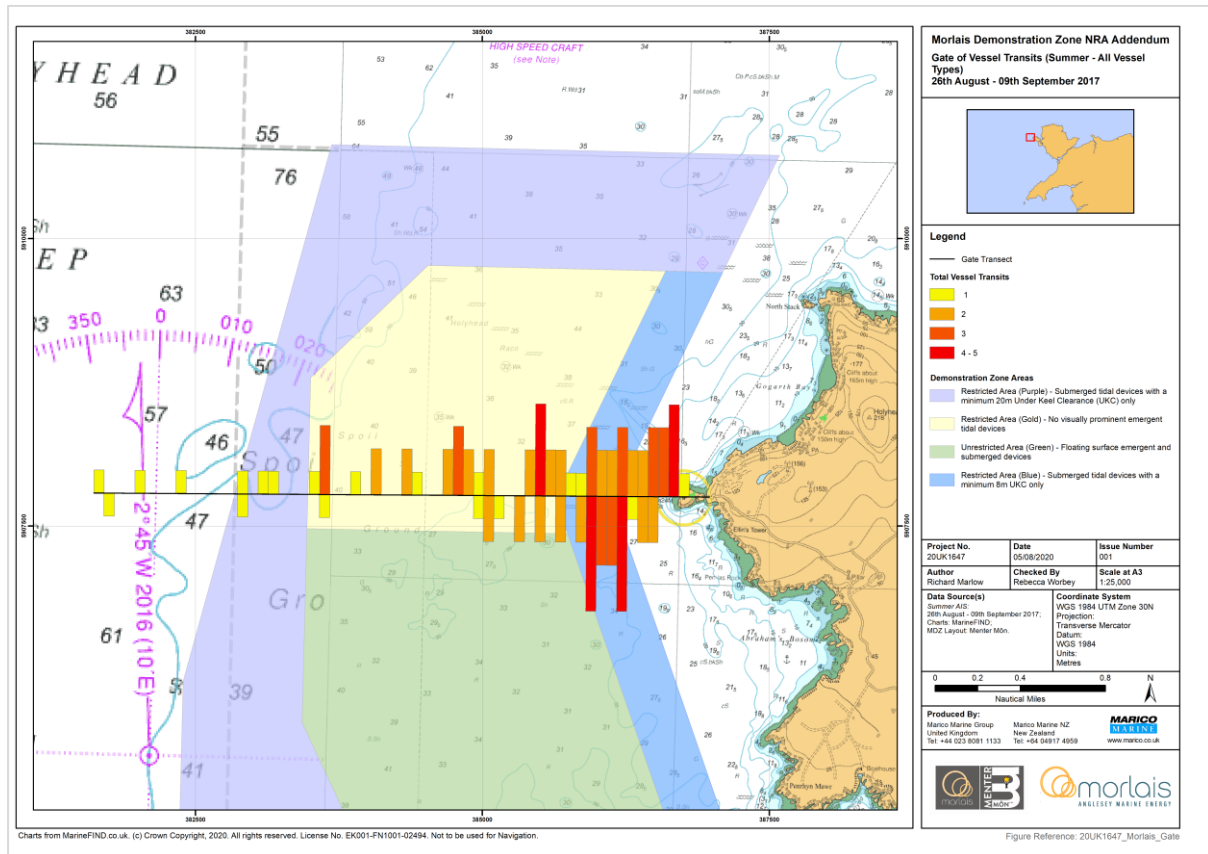


Figure 17: Transits through EW gate (July 2017)

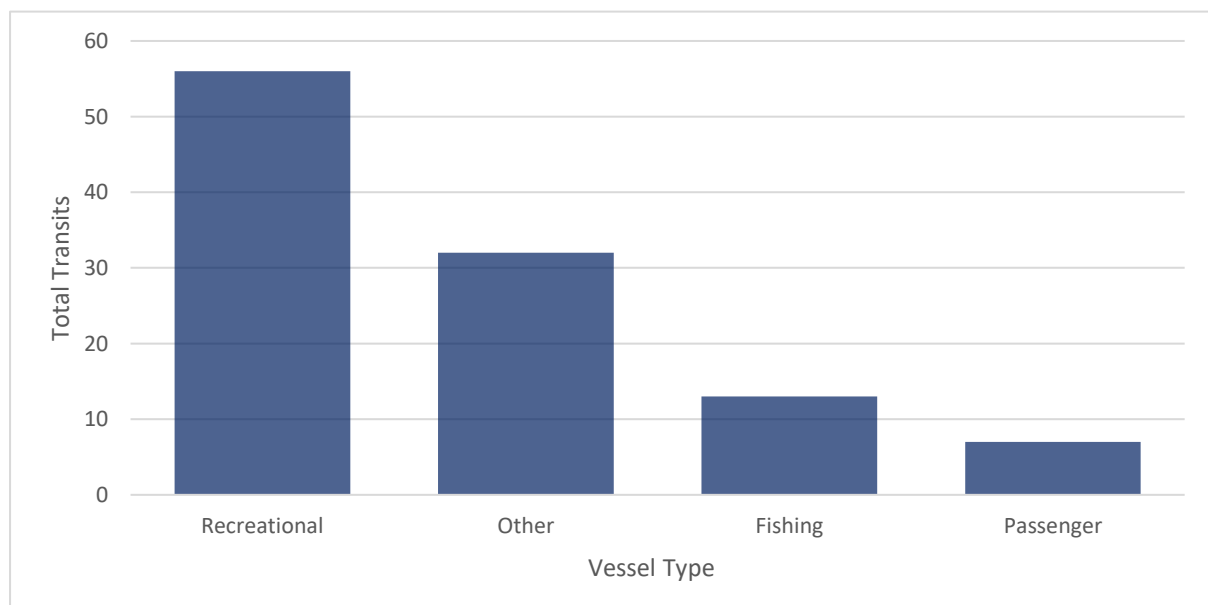


Figure 18: Frequency of transits by vessel type

Figure 19 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 cruise ships *Hebridean Sky* (LOA 90m) and *Corinthian* (LOA 88m).

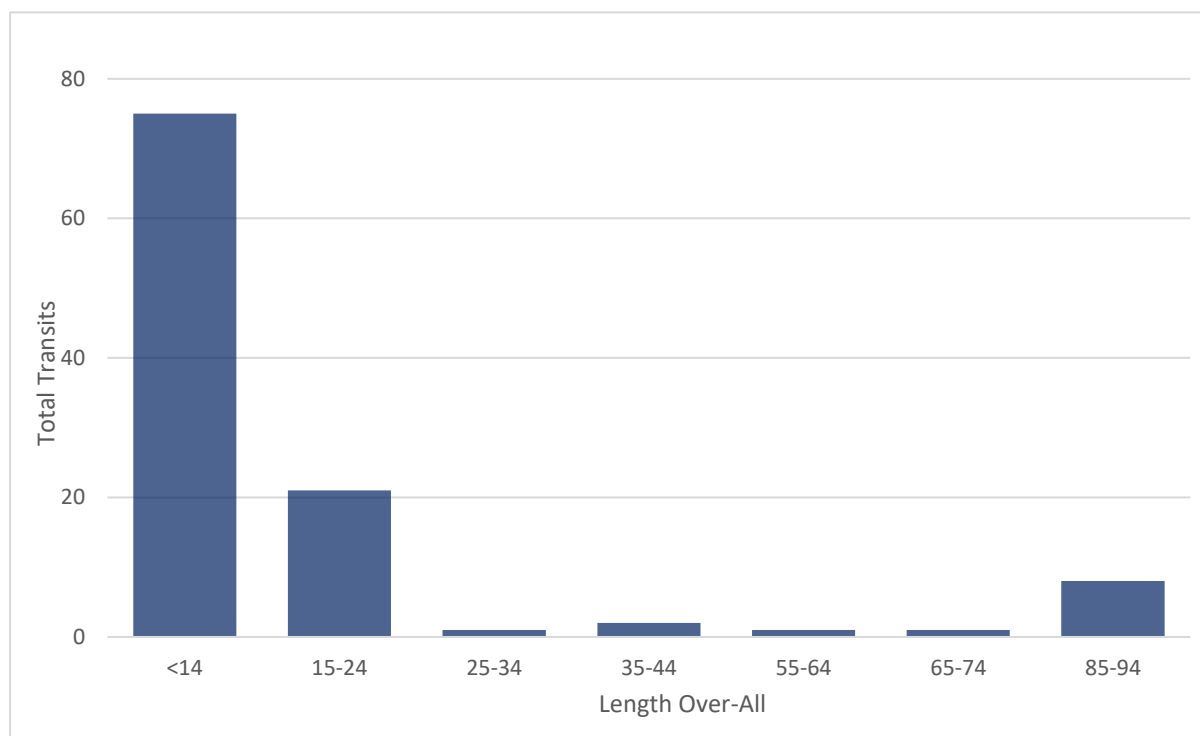


Figure 19: Vessel transits by LOA

Transits through the gates were analysed by draught within **Figure 20**. 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).

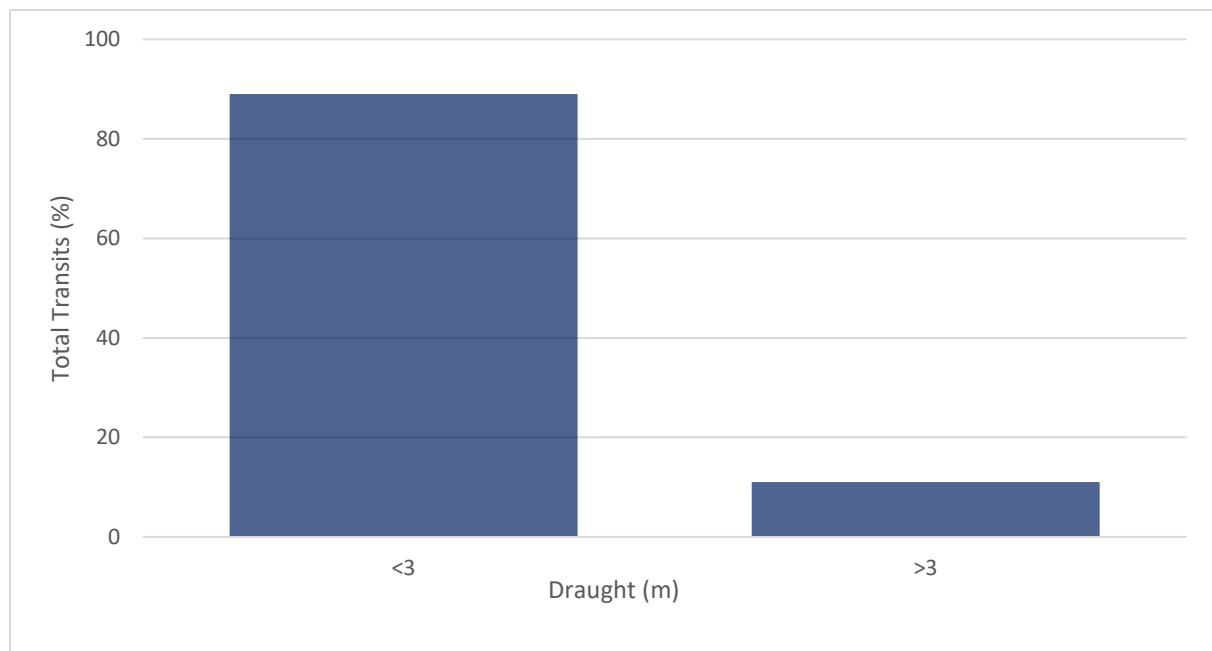


Figure 20: Vessel transits by Draught

7.7 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.

7.7.1 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 MDZ:

- 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 MDZ¹⁴;
- 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 MDZ (It is noted

¹⁴ MMO (2017) Scoping Opinion; Port of Holyhead – Holyhead Port Expansion: DC10119

that It was reported on 17 January 2019 that plans for the construction of the nuclear power station on Anglesey had been suspended/ delayed).

8 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 MDZ and geographic areas of high-risk were analysed and are represented within **Figure 21**.

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.

8.1 MAIB ACCIDENT REPORTS

Figure 21 shows marine accidents investigated by the MAIB in proximity to the MDZ between 1997 and 2017. There were a total of 14 separate MAIB incidents recorded within 1nm, of which, one is 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.’¹⁵

¹⁵ Marine Accident Investigation Branch (2015)

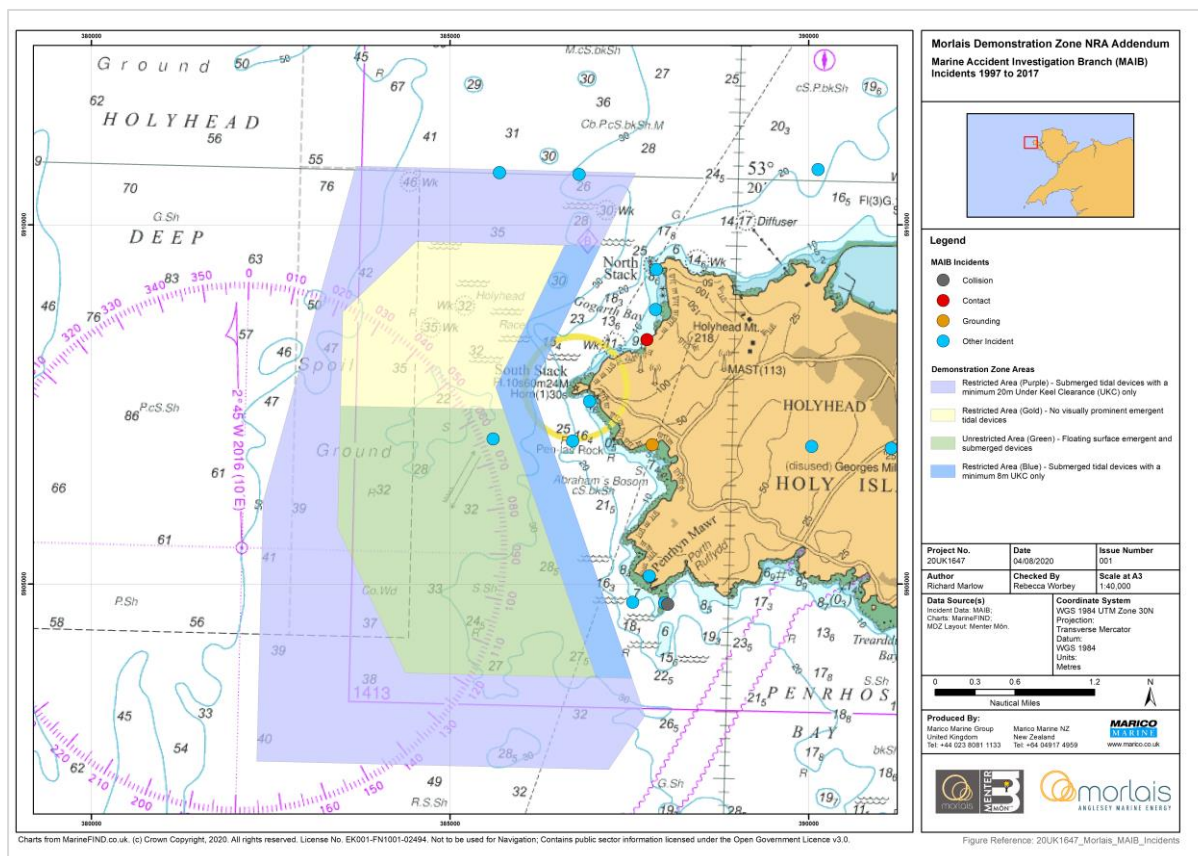


Figure 21: MAIB incidents 1997 – 2017

It was additionally 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.

8.2 RNLI CALLOUTS

RNLI callouts are shown within **Figure 22**. A total of 125 callouts occurred within 1nm of the MDZ, 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 MDZ, of which, 12 or 57% were in response to recreational vessels. 50% of callouts within the MDZ occurred in 2008 and 2012, the busiest years for callouts. There were 2 callouts per year between 2014 and 2016 within the MDZ.

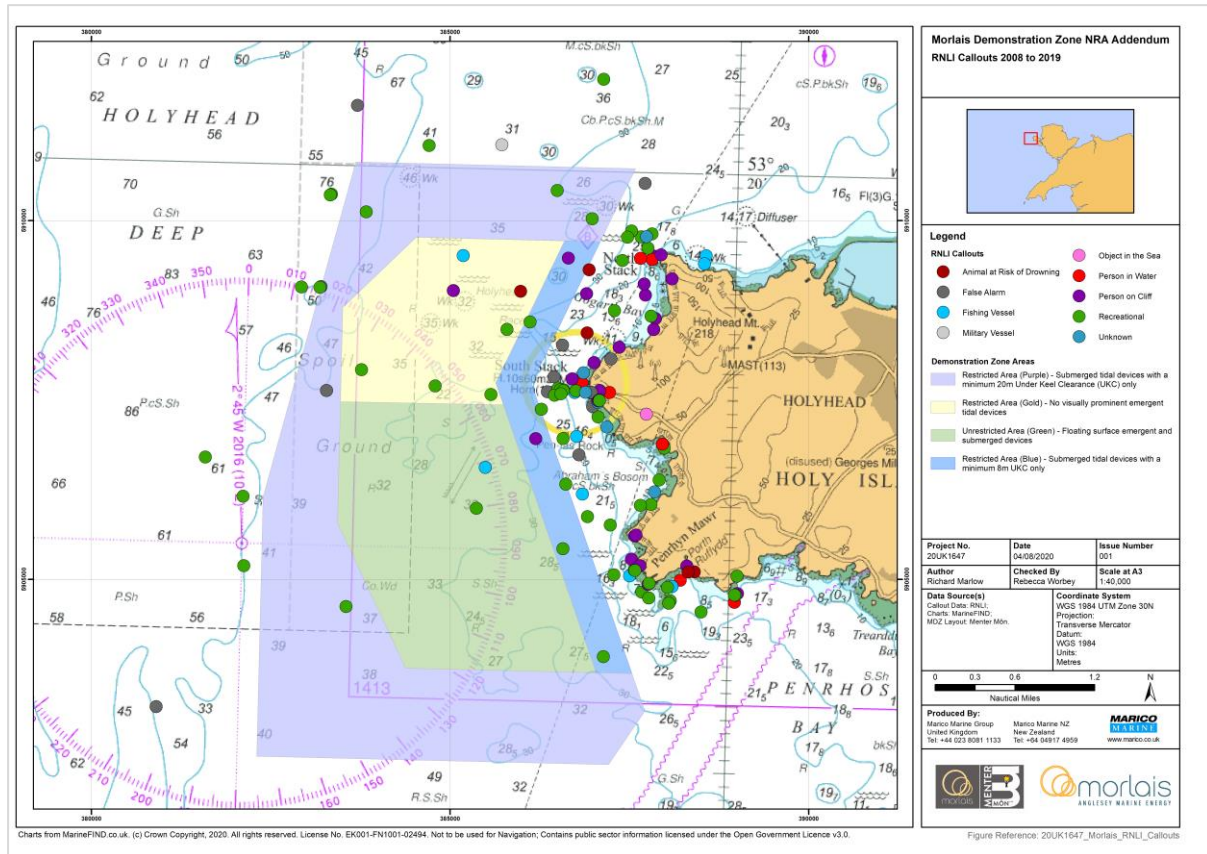


Figure 22: RNLI Callouts within 1nm – 2008 to 2016.

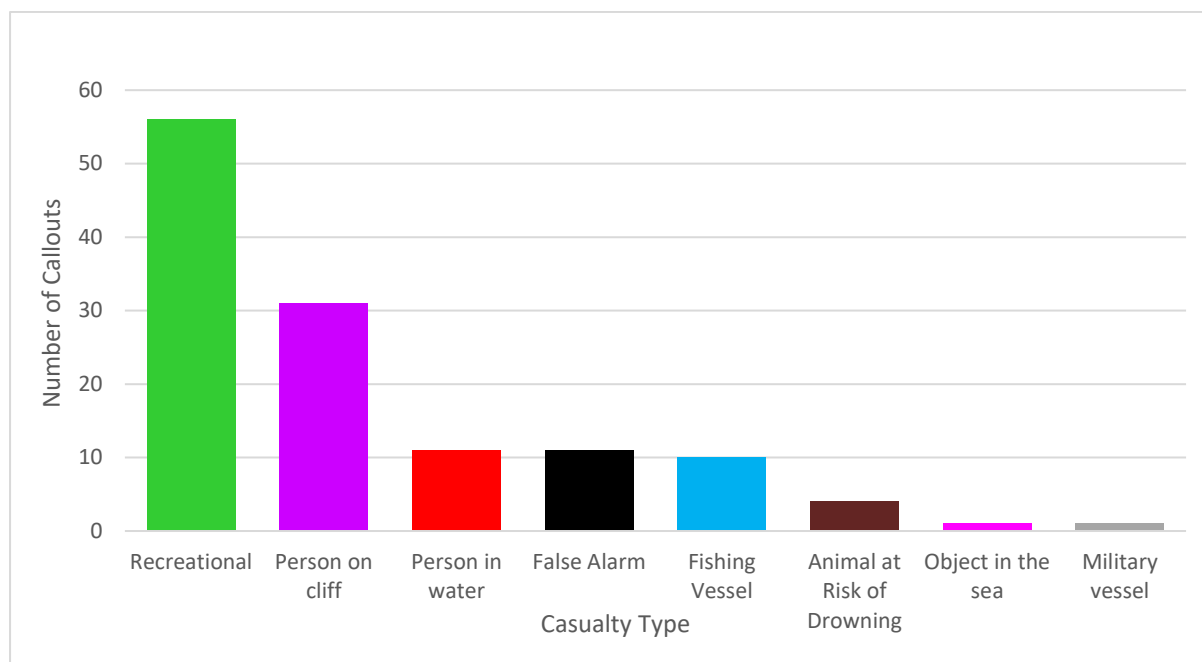


Figure 23: RNLI Callouts within 1nm by Casualty Types -2008 to 2016

9 MET-OCEAN IMPACTS

9.1 HR WALLINGFORD COASTAL PROCESSES MODELLING REPORT

9.1.1 Tidal Stream

Since completion of the 2019 NRA, a Coastal Processes Modelling Report (CPMR) was completed by HR Wallingford in March 2020¹⁶. The assessment utilised a validated flow model to assess tidal current flow speed variations resulting from the presence of the proposed worst-case scenario on flow speeds.

The results of the predicted changes to tidal streams induced by the scheme were presented as differences in maximum flow speeds and differences in average flow speeds. The study found that the difference in maximum speeds at spring tides varies between a decrease of 0.7 m/s (1.3 knots) within the MDZ sub-zones and an increase of 0.3 m/s (0.6 knots) between the MDZ and the shore (inshore route). The difference in average speeds is mostly a decrease up to 0.2 m/s (0.4 knots) within the MDZ.

Presuming that the Eastern Inshore Route is between the MDZ and the coast, then the worst-case differences in maximum flow speeds are a reduction of up to 0.3m/s and an increase up to 0.3m/s across the length and width of the Route (**Figure 1**). The largest area of change south of South Stack is a decrease and north of South Stack is an increase. With respect to average speeds, the changes are much smaller both in magnitude and spatially. Most of the Route is affected by changes to currents of +/- 0.1m/s with small areas where the speeds reduce or increase by up to 0.2m/s.

9.1.2 Waves

The CPMR additionally assessed the impact of the worst-case MDZ layout on waves utilising a highly resolved Simulating Waves Nearshore (SWAN) model. The differences in maximum heights were found to be located mainly within the MDZ and to vary between a decrease of 0.4 m and an increase of 0.2 m, based on representative wind speeds of 13 m/s (Force 6) and above. Prudent recreational users, particularly un-powered recreational, would not normally be expected to be navigating in the area in Force 6 or above under normal passage planning (see **Annex F**).

¹⁶ 06_MOR-HRW-DOC-0001_HR Wallingford Coastal Processes Modelling Report

Waves from all directions were found to reduce within the MDZ as the structures dissipate wave energy. In areas either side of the development area, where current velocities increase, the waves increase post construction of the devices due to shoaling of waves in opposing flows. However, these increases in wave heights are predominantly away from the coastline with waves from 300°N and 330°N still seeing a reduction in wave heights.

For both representative and extreme wave conditions across the Eastern Inshore Route, the wave heights generally reduce in height from the baseline with the scheme in place. The largest predicted reduction in wave heights is for waves approaching from the west where the predicted reductions for representative waves are between 0.1m and 0.6m. For extreme waves, the lowering of wave heights is predicted to be between 0.2m and 1.2m across the Route.

For all wave directions, the effects of changes in tidal streams and resulting shoaling under some tidal conditions due to the turbines have a small impact over a wider area than the direct impact from the structures themselves. There will likely be a combined effect which is likely to be small and localised.

The changes in flow speeds and wave heights are therefore considered to be minimal and of low significance in terms of impact to navigation risk across all vessel types.

MGN 543 Annex 2 sets out the requirement for consideration of the effect of tides and tidal streams which are further discussed, with reference to the CPMR17 in Table 9-1 .

¹⁷ 06_MOR-HRW-DOC-0001_HR Wallingford Coastal Processes Modelling Report

Table 9-1: MGN 543, Annex 2 – The effects of tides, tidal streams and weather

| MGN 543, Annex 2 | | NRA Response | Ref |
|--|---|--|----------------------------------|
| The Effect of Tides and Tidal Streams. It should be determined whether: | | | |
| A | Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa. | <ul style="list-style-type: none"> UKC calculated to determine required minimum UKC for all vessels at all states of tide. | Section 9 |
| | | <ul style="list-style-type: none"> Zones of minimum UKC recommended from 2019 NRA embedded into project design. | Section 11.4 |
| B | The set and rate of the tidal stream, at any state of the tide, has a significant effect the handling of vessels in the area of the OREI site. | <ul style="list-style-type: none"> The impacts of the MDZ on the tidal streams in the area are assessed within the HR Wallingford CPMR¹⁸ and the predicted changes are assessed to be of low significance in terms of impact to navigation risk across all vessel types. The effect of the tidal set and rate on the handling of vessels in the area of the MDZ are considered to be of similar impact as the current baseline. The effect of the tidal streams should be considered as part of normal passage planning. | Section 9.1 |
| | | <ul style="list-style-type: none"> Equipment / Mechanical Failure and Loss of Control considered as causal factors within the risk assessment. | Annex B Annex C |

¹⁸ HR Wallingford (2020) DER6261-RT001-R02-00 – Morlais Demonstration Zone Coastal Processes

| MGN 543, Annex 2 | | NRA Response | Ref |
|------------------|---|---|----------------------------------|
| | | <ul style="list-style-type: none"> Analysis of historical incident data identified that the historical incident rate given the baseline tidal conditions is low. | Section 8 |
| C | The maximum rate tidal stream runs parallel to the major axis of the proposed OREI site layout, and if so, its effect on vessel handling and manoeuvring. | <ul style="list-style-type: none"> The maximum rate tidal stream runs parallel to the major axis of the proposed MDZ and eastern inshore channel. In the event of an equipment or mechanical failure, vessels in the eastern passage are unlikely to be set onto the devices within the MDZ, however, vessels navigating within the MDZ could be set onto devices in the vicinity. | - |
| D | The set is across the major axis of the OREI layout at any time, and, if so, at what rate. | <ul style="list-style-type: none"> The maximum rate tidal stream runs parallel to the major axis of the proposed MDZ and eastern inshore channel. In the event of an equipment or mechanical failure, vessels in the eastern passage are unlikely to be set onto the devices within the MDZ, however, vessels navigating within the MDZ could be set onto devices in the vicinity. | - |
| E | In general, whether engine and/or steering failure, or other circumstance could cause vessels to be set into danger by the tidal stream. | <ul style="list-style-type: none"> Equipment / Mechanical Failure and Loss of Control considered as causal factors within the risk assessment (See also C and D above). | Annex B Annex C |
| F | The structures themselves could cause changes in the set and rate of the tidal stream. | <ul style="list-style-type: none"> The impacts of the MDZ to the tidal stream are assessed within the HR Wallingford CPMR¹⁹ and are assessed to be minimal and of low | Section 9.1 |

¹⁹ HR Wallingford (2020) DER6261-RT001-R02-00 – Morlais Demonstration Zone Coastal Processes

| MGN 543, Annex 2 | | NRA Response | Ref |
|--|--|--|---------------------|
| | | significance in terms of impact to navigation risk across all vessel types. The effect of the tidal set and rate on the handling of vessels in the area of the MDZ are considered to be of similar impact to the current baseline. The effect of the tidal stream should be considered as part of normal passage planning. | |
| G | The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the OREI area or adjacent to the area. | <ul style="list-style-type: none"> The MDZ is predicted to have little impact on this residual sediment transport. As detailed within the HR Wallingford CPMR²⁰. | - |
| Weather. It should be determined whether: | | | |
| A | The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to all vessels that might pass through or in close proximity to it. | <ul style="list-style-type: none"> Adverse Environmental Conditions and Poor Visibility are identified as causal factors in the assessment of navigation risk. | Annex B |
| | | <ul style="list-style-type: none"> Mitigation measure 'Marked in accordance with Trinity House' embedded in project. | Annex C |
| | | <ul style="list-style-type: none"> Additional mitigation 'Undertake Device /Array Specific Risk Assessments to include NavAids and Marker Buoys' suggested. | Section 11.4 |
| | | | Section 13 |

²⁰ HR Wallingford (2020) DER6261-RT001-R02-00 – Morlais Demonstration Zone Coastal Processes

| MGN 543, Annex 2 | | NRA Response | Ref |
|------------------|---|---|----------------------------------|
| B | The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer. | <ul style="list-style-type: none"> The design of the devices are expected to have a low freeboard and are unlikely to cause wind masking, turbulence and sheer (unlike for windfarms). | - |
| C | In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above. | <ul style="list-style-type: none"> The prevailing winds in the area of the MDZ are in the south-westerly quadrant and the Holy Island coast remains the predominant lee shore hazard. (See also A to G above). | Section 4.1 |
| | | <ul style="list-style-type: none"> 'Grounding / Forced Ashore' identified as a primary hazard within the risk assessment. | Section 11.2 |
| | | <ul style="list-style-type: none"> Hazard 'Grounding / Forced Ashore' assessed for all vessel types. | Annex B Annex C |

10 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.

10.1 VESSEL DRAUGHTS

Vessel transits through the MDZ by draught between 1st October 2017 and 31st March 2018 are given in **Figure 24**.

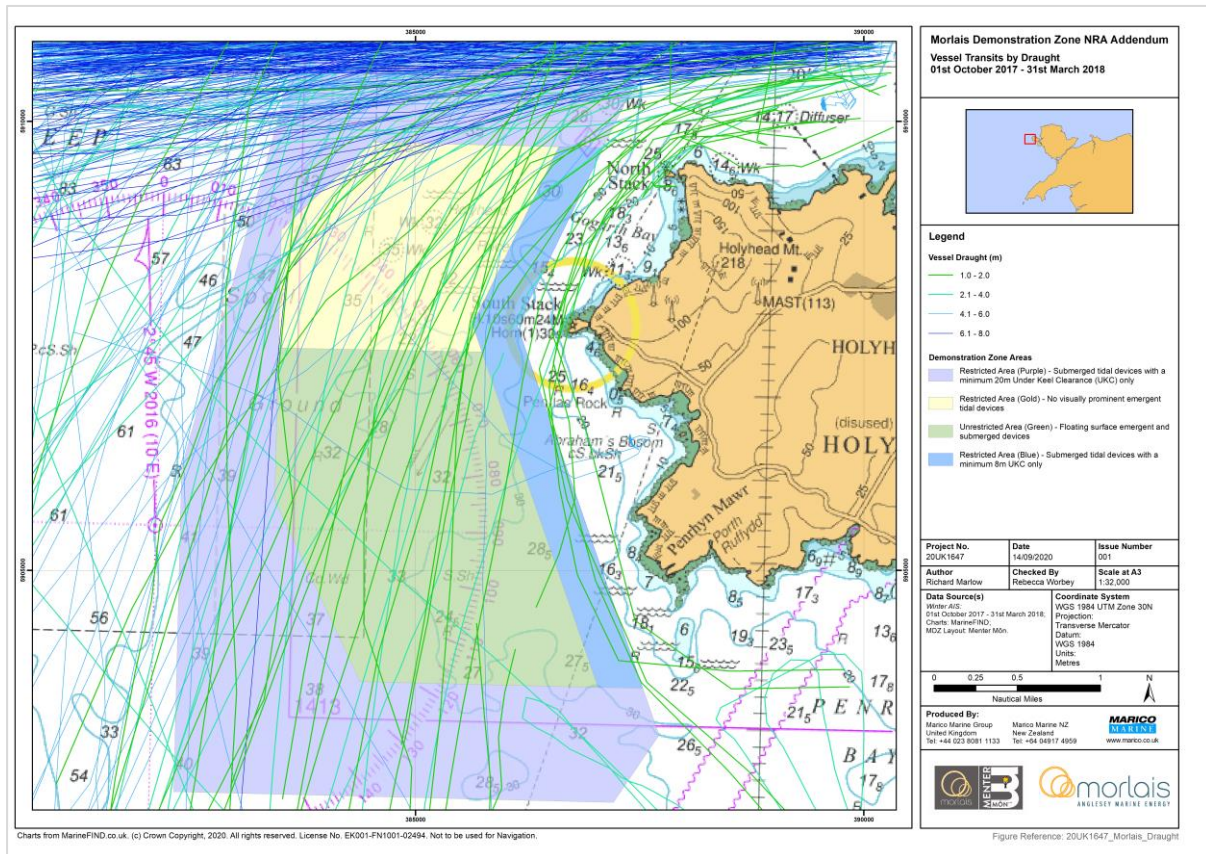


Figure 24: Transits by draught (AIS only) - 1st October 2017 and 31st March 2018

The top five maximum draught vessels transiting within, or within close proximity to, the MDZ are detailed in **Table 10-1**. These vessels transited to the north and the west of the MDZ.

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 MDZ. 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 MDZ. 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’²¹.

²¹ Admiralty Sailing Directions NP37 West Coast of England And Wales Pilot, 20th Edition 2017

Table 10-1: Maximum draughts identified within MDZ- 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 Paper (UCKP) ²², ‘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.’

The UKCP states that device height including a vertical safety margin along with vessel draught are two key factors that need to be considered when determining UKC. 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 MDZ, feedback was received during local consultation in relation to vessel UKC which is summarised within **Table 10-2**.

²² 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 10-2: Consultation feedback - 2019 NRA Consultation– 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. |

10.2 UKC SUMMARY

Given that the devices to be deployed at Morlais are unknown, the calculation as described in the policy paper were unable to be applied to known tidal device scenarios. In lieu of known device heights, the NRA focuses instead on establishing the minimum required vessel UKC (draught*dynamic factor* safety margin) that the commercial operators require to maintain safe passage, irrespective of tidal device, which was informed by consultation.

The draughts of passenger vessels operating in vicinity of the MDZ and the corresponding required UKC for each vessel, given the approach above, are shown within **Table 10-3**. where:

Dynamic factor : 2 x draught to account for vessel motions in accordance with PIANC principles.

Safety Margin : 30% as stipulated within MCA UKC Policy Paper.

Table 10-3: Passenger Vessel Draughts and Required UKC.

| Vessels | Draught | Required Vessel UKC (m) |
|---------------|---------|-------------------------|
| OSCAR WILDE | 6.7 | 17.4 |
| SUPERFAST X | 6.6 | 17.2 |
| ULYSSES | 6.5 | 17 |
| STENA HORIZON | 6.5 | 17 |

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 10-4**.

Table 10-4: 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 13**) will be required in order to mitigate contact hazards.

Given that the devices to be deployed at Morlais are unknown and the calculation as described in the policy paper was unable to be applied to known tidal device scenarios It is recommended that UKC should be assessed on a case by case basis for each device within array Specific Navigation Risk Assessments.

11 NAVIGATION RISK ASSESSMENT

11.1 METHODOLOGY

Following vessel traffic analysis and stakeholder consultation a risk assessment was undertaken to assess the navigation risk during both the construction and operational phases of the project. The construction and operation phases are assessed independently. The construction phase assesses the risks to navigating vessels during both the construction phase - anticipated to span approximately 10 years and during repowering which is considered to be the replacement of one array of tidal devices with another array of tidal devices, normally with a different newer or updated technology.

The risk assessments were conducted in accordance with the International Maritime Organisation (IMO) Formal Safety Assessment (FSA) methodology for risk assessments. A detailed description of the methodology is provided in **Annex A**.

This NRA was commissioned to assess the impact on navigation potentially caused by the construction and operation of the MDZ 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 MDZ 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 13**).

11.2 HAZARD IDENTIFICATION

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

The primary hazard categories identified for assessment within the NRA are outlined within **Table 11-1**.

Table 11-1: Hazard Categories

| Ref | Hazard Category | Hazard Detail | Comments | Individual Assessed Hazards | |
|------------------------|--|----------------------|--|-----------------------------|-----------------|
| | | | | Construction Phase | Operation Phase |
| 1 | Contact | Surface Device | One or more vessels makes contact with a surface device. | 7 | 6 |
| | | Device <8m below CD | One or more vessels makes contact with a submerged device <8m below CD or a marker buoy. | 7 | 6 |
| | | Device >8m below CD | One or more vessels makes contact with a submerged device >8m below CD or a marker buoy. | 7 | 6 |
| | | Device >20m below CD | One or more vessels makes contact with a submerged device >20m below CD or a marker buoy. | 7 | 6 |
| | | Electrical Hubs | One or more vessels makes contact with an electrical hub. | 7 | 6 |
| 2 | Collision | All Vessel Types | A vessel collides with another vessel (Including construction vessels not underway). | 28 | 21 |
| 3 | Grounding / Forced Ashore | All Vessel Types | A vessel unintentionally makes contact with the seabed or is forced ashore onto the cliffs. | 7 | 6 |
| 4 | Swamping / Capsize | All Vessel Types | A vessel fills with water for any reason including capsize, and when overwhelmed, sinks. | 7 | 6 |
| 5 | Snagging / Obstruction | All Vessel Types | Gear (e.g. fishing gear or anchor) snags on submerged device, mooring arrangements or export cables. | 7 | 6 |
| 6 | Breakout / Device not at stated depth. | All Device Types | Device breaks its moorings and becomes a hazard to shipping or runs aground (including during construction works). | 1 | 1 |
| Total Hazards Assessed | | | | 85 | 70 |

In order to focus the assessment of navigation risk within the MDZ, vessel types have been grouped into vessel categories outlined in **Table 11-2**. These categories are a factor of vessel type; established from analysis undertaken within **Section 6**, and draught; as informed by the assessment of UKC within **Section 9**.

Table 11-2: Vessel Categories

| Ref | Vessel Type Category | Draught | Including |
|-----|---|---------|---|
| 1 | Commercial Vessel | >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 | Project Vessels (Construction phase only) | >3m | Barges, DP heavy-lift vessels, rock dumpers, cable laying vessels etc. |
| 4 | Fishing Vessel | <3m | Fishing Vessels |
| 5 | Powered Recreational Vessel | <3m | Yachts, power boats, recreational RIBs, Recreational fishing boats. |
| 6 | Un-Powered Recreational Vessel | <3m | Sailing dinghies, kayaks, canoes, rowing boats, SUPs. |
| 7 | Other Vessel | <3m | Tugs and tows, survey vessels, RNLI, small construction and maintenance vessels, workboats, commercial RIBs. |

The device categories considered within the NRA are outlined within **Table 11-3**. Device depths were informed by stakeholder consultation and the assessment of UKC within **Section 9**.

Table 11-3: 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 |

Hazards were assessed according to two distinct project phases; operation and construction. 85 individual hazards were identified for assessment within the construction phase and 70 individual hazards for the operational phase (**Table 11-1**). A full list of hazard categories is located within **Annex B** – construction phase assessment and **Annex C** – operational phase assessment.

11.3 ASSUMPTIONS

The NRA has been undertaken based upon information provided by the client at the time of commencement. The assumptions outlined within **Table 11-4** are, therefore, applicable to the NRA.

Table 11-4:NRA Assumptions

| Assumption | Description |
|---|---|
| Utilisation of worst-case maximum capacity (240MW). | A Project Design Envelope (PDE) approach to consent is sought for an array of up to 240MW installed capacity. Therefore, a device specific layout has not been provided prior to undertaking the NRA. Full deployment to a worst-case of 240 MW could comprise up to a maximum of 620 tidal devices, supporting up to 1,648 TECs and up to 740 inter-array cables within the MDZ. |
| Any device type may be deployed within any zone in accordance with embedded required minimum UKC. | The Project will install multiple technology types. Device types will be determined through consideration of the direction of future developments and technology. The deployment of any device within any zone of the MDZ in line with embedded minimum UKC requirements has been considered to represent the worst case. |
| Each single array will be comprised of the same type of tidal device / technology. | Each array will consist of uniform device/ technology types of approximately 30 MW installed capacity per array. |
| 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 exact locations of the cable routes have not yet been determined, however, they will make landfall at Abrahams Bosom. |
| Embedded mitigation measures are in place prior to construction. | Embedded mitigation listed within Table 11-5 are assumed to be in place and as such are reflected in the scores. |
| Displaced traffic due to MDZ. | Hazard assessment informed by traffic analysis assumes the worst-case displacement of traffic into the areas around the MDZ. |

11.4 EMBEDDED MITIGATION MEASURES

The embedded risk control measures listed within **Table 11-5** were assumed to be in place when scoring the NRA.

Table 11-5: 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 | 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. ²³ |
| 5 | Marked in accordance with Trinity House | Devices to be marked in accordance with MGN 543 and to comply with IALA standards. |
| 6 | 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 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. 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. ²⁴ |

²³ Marine Accident Investigation Branch (2017) Marine Casualty and Marine Incident Reporting, MGN 564 (M+F)

²⁴ 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);

| ID | Embedded Risk Control | Description |
|----|---|--|
| 7 | 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. The MCA document ' <i>Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response</i> ' outlines the SAR requirements. This will include details of access to a safe havens and places of refuge in the event of an emergency or stress of weather. |
| 8 | Passage plans for construction and maintenance craft | Development of routeing plans between site and offshore base. |
| 9 | Consideration of weather and sea state during construction planning | Limit hazardous activities during adverse weather conditions. |
| 10 | Devices >8m minimum UKC below CD to be deployed within the blue area Figure 1 . | To increase space for navigation within the inshore passage for small vessels (draught <3m). |
| 11 | Devices >20m minimum UKC below CD deployed within the purple area Figure 1 . | To increase available space for navigation of large vessels (>3m draught) including fair weather and poor weather ferry routes. |
| 12 | Global Positioning System off station alarm / Supervisory Control and Data Acquisition (SCADA) monitoring system. | - |
| 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. |

Maritime and Coastguard Agency (2014) Hydrography Guidelines for Offshore Developers;
Maritime and Coastguard Agency (2014) Offshore Developers: Post-Construction Hydrographic Guidelines

12 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** and **Annex C**. The assessment was undertaken utilising the FSA²⁵ five step approach. 85 individual hazards were assessed for the construction phase and 70 for the operation phases.

A summary of the top ranked hazards for both construction and operation phases of the MDZ is shown in **Table 12-2** and **Table 12-3**. 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 **In total** 19 hazards and 6 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 13**).

Table 12-1.

In total 19 hazards and 6 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 13**).

Table 12-1: Baseline 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 | 0 | 0 |
| ALARP | Between 4 to 6.99 | 19 | 6 |
| Low Risk | Between 2 to 3.99 | 47 | 46 |
| Negligible Risk | Between 0 to 1.99 | 3 | 3 |
| N/A | N/A | 16 | 21 |

²⁵ International Maritime Organisation (2018) Revised Guidelines for Formal Safety Assessment (FSA) MSC-mepc.2/Circ.12/Rev.2

The hazards scoring ALARP within the baseline construction phase assessment are shown below in **Table 12-2**. A full list of ranked hazard scores is located within **Annex B**.

The top ten hazards identified for the baseline operational phase of project are shown below in **Table 12-3**. A full list of ranked hazard scores are located within **Annex C**.

Table 12-2: Top hazards scoring ALARP - Construction Phase

| Rank | ID | Hazard Title | Baseline Risk Score |
|------|----|--|---------------------|
| 1 | 10 | Contact Project Vessel with Mid-Water Device (<8m below CD) | 5.28 |
| 2 | 68 | Grounding / Forced Ashore Powered Recreational Vessel | 5.27 |
| 3 | 63 | Collision Other Vessels ICW Other Vessels | 5.13 |
| 4 | 11 | Contact Fishing Vessel with Mid-Water Device (<8m below CD) | 5.00 |
| 5 | 7 | Contact Other Vessels with Surface Device | 4.72 |
| 6 | 14 | Contact Other Vessels with Mid-Water Device (<8m below CD) | 4.72 |
| 7 | 85 | Breakout of device / device not at stated depth | 4.72 |
| 8 | 53 | Collision Project Vessel ICW Other Vessel | 4.63 |
| 9 | 49 | Collision Project Vessel ICW Project Vessel | 4.53 |
| 10 | 81 | Snagging/ Obstruction Fishing Vessel | 4.50 |
| 11 | 12 | Contact Powered Recreational Vessel with Mid-Water Device (<8m below CD) | 4.47 |
| 12 | 60 | Collision Powered Recreational Vessel ICW Other Vessel | 4.47 |
| 13 | 3 | Contact Project Vessel with Surface Device | 4.38 |
| 14 | 58 | Collision Powered Recreational Vessel ICW Powered Recreational Vessel | 4.35 |
| 15 | 76 | Swamping / Capsize Un-Powered Recreational Vessel | 4.13 |
| 16 | 80 | Snagging / Obstruction Project Vessels | 4.13 |
| 17 | 35 | Contact Other Vessels with Electrical Hubs | 4.07 |
| 18 | 9 | Contact Passenger Vessels with Mid-Water Device (<8m below CD) | 4.06 |
| 19 | 43 | Collision Passenger Vessel ICW Passenger Vessel | 4.00 |

Table 12-3: Top ten hazards - Operational Phase

| Rank | ID | Hazard Title | Baseline Risk Score |
|------|----|--|---------------------|
| 1 | 55 | Grounding / Forced Ashore Powered Recreational Vessel | 4.67 |
| 2 | 66 | Snagging/ Obstruction Fishing Vessel | 4.50 |
| 3 | 9 | Contact Fishing Vessel with Mid-Water Device (<8m below CD) | 4.23 |
| 4 | 62 | Swamping / Capsize Un-Powered Recreational Vessel | 4.13 |
| 5 | 10 | Contact Powered Recreational Vessel with Mid-Water Device (<8m below CD) | 4.01 |
| 6 | 37 | Collision Passenger Vessels ICW Passenger Vessel | 4.00 |
| 7 | 8 | Contact Passenger Vessels with Mid-Water Device (<8m below CD) | 3.82 |
| 8 | 30 | Contact Other Vessels with Electrical Hubs | 3.72 |
| 9 | 44 | Collision Fishing Vessel ICW Un-Powered Recreational Vessel | 3.67 |
| 10 | 46 | Collision Powered Recreational Vessel ICW Powered Recreational Vessel | 3.64 |

13 SUGGESTED ADDITIONAL RISK CONTROL MEASURES

While all of the of hazards identified and scored for this risk assessment fell into the ALARP or below categories of risk (see **Section 11**), 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 13-1**. 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 MDZ Navigation Safety Management System (NSMS) to assess changes to the vessel traffic profile throughout the life of the project.

Table 13-1: Suggested 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 Gold and Green MDZ Zones. | <p>For example; via designation of site as an Area To Be Avoided (ATBA) or Precautionary Area (PA).</p> <p>In the UK, all vessels have freedom to transit through OREIs, subject to any applied safety zones, and their own risk assessments and passage plans, which should take account of factors such as vessel size, manoeuvrability, environmental factors and competency of the Master and crew. MGN 372²⁶ (or subsequent update) provides further guidance on navigation in and around OREIs.</p> <p>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 navigation²⁷.</p> <p>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. ²⁸</p> | All Phases |
| 3 | MDZ designation as No Fishing Zone | To prevent fishing gear snagging on underwater devices and their associated infrastructure. | All Phases |
| 4 | 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.[3] | All Phases |

²⁶ Maritime and Coastguard Agency (2008) MGN372 (M+F) Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs.

²⁷ International Maritime Organisation (1985) General Provisions on Ships' Routeing, adopted Nov. 20, 1985, IMO Resolution A.572(14).

²⁸ International Maritime Organisation (1985) General Provisions on Ships' Routeing, adopted Nov. 20, 1985, IMO Resolution A.572(14).

| ID | Risk Control | Description | Phase |
|----|--|---|--------------|
| | | <p>In order to minimise risks to surface vessels transiting through an OREI, structures (turbines, substations etc) should be aligned and in straight rows or columns. Multiple lines of orientation provide alternative options for passage planning and for vessels to counter the environmental effects on handling i.e. sea state, tides, currents, weather, visibility etc. Developers should plan for at least two lines of orientation unless they can clearly demonstrate that fewer is acceptable.</p> <p>The MCA document 'Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response' outlines the SAR requirements.</p> <p>See also 15: 'Undertake Device / Array Specific Risk Assessments'</p> <p>It was noted during consultation with recreational stakeholders that 'if surface devices are spaced adequately then sailing could occur between them, although this would not be recommended at night'.</p> | |
| 5 | 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. | All Phases |
| 6 | 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 |
| 7 | Establish no anchoring areas | No anchoring areas to be established around nearshore cable route. | All Phases |
| 8 | 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 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. ²⁹ | All Phases |
| 9 | 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 |
| 10 | 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 |

²⁹ MGN 543

| ID | Risk Control | Description | Phase |
|----|---|---|--------------|
| 11 | Undertake Device / Array Specific Risk Assessments to include NavAids and Marker Buoys. | <p>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.</p> <p>MCA has statutory obligations to provide Search and Rescue (SAR) services in and around OREIs in UK waters. Turbine layout designs must be designed to allow safe transit through OREIs by SAR helicopters operating at low altitude in bad weather, and those vessels (including rescue craft) that decide to transit through them. Developers should therefore carry out further site-specific assessment to build on previous assessments to assess the proposed locations of individual turbine devices, substations, platforms and any other structure within the wind farm or tidal/wave array. This assessment should include the potential impacts the proposed location may have on navigation and SAR activities.</p> <p>Risk assessments for proposed layouts should build on earlier work conducted as part of the Navigation Risk Assessment and the mitigations identified as part of that process. Where possible, this original assessment should be referenced to confirm where information or the assessment remains the same or can be further refined due to the later stages of project development</p> | Construction |
| 12 | Provision of life saving equipment on fixed structures and floating devices. | Provide a refuge for people in the water for example; grab chains and ladders. | All Phases |
| 13 | Minimise use of marker buoys in zones of minimum UKC. | To reduce the risk of contact with buoys by vessels navigating in the zones of minimum UKC. It was reported by recreational stakeholders in consultation that <i>'if the devices are under water with a sufficient UKC preference would be that there is no buoy at the surface to maintain navigation'</i> . | All Phases |

14 RESIDUAL RISK ASSESSMENT

The risk assessment was re-assessed following the implementation of the suggested risk control measures. A breakdown of the individual hazards to which each suggested mitigation measure applies is shown in **Annex B** and **Annex C**.

A summary of the top ranked residual hazards for both construction and operation phases of the MDZ is shown in **Table 12-2** and **Table 12-3**. A breakdown of the hazard scores for the residual assessment of risk (i.e. risk with suggested mitigation measures) for each project phase is summarised within In total 19 hazards and 6 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 13**).

Table 12-1.

In total 6 hazards and 3 hazards score higher than 4 (low-risk) in the residual assessment for the construction and operation phases.

Table 14-1: Residual 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 | 0 | 0 |
| ALARP | Between 4 to 6.99 | 6 | 3 |
| Low Risk | Between 2 to 3.99 | 59 | 51 |
| Negligible Risk | Between 0 to 1.99 | 4 | 1 |
| N/A | N/A | 16 | 21 |

The hazards scoring ALARP within the residual construction phase assessment are shown below in. A full list of ranked hazard scores is located within **Annex B**.

The top ten hazards identified for the baseline operational phase of project are shown below in Table 12-3. A full list of ranked hazard scores are located within **Annex C**.

Table 14-2: Top 10 ranking residual hazards – Construction Phase

| Rank | ID | Hazard Title | Residual Score |
|------|----|--|----------------|
| 1 | 68 | Grounding / Forced Ashore Powered Recreational Vessel | 4.93 |
| 2 | 49 | Collision Project Vessel ICW Project Vessel | 4.53 |
| 3 | 10 | Contact Project Vessel with Mid-Water Device (<8m below CD) | 4.38 |
| 4 | 76 | Swamping / Capsize Un-Powered Recreational Vessel | 4.13 |
| 5 | 35 | Contact Other Vessels with Electrical Hubs | 4.07 |
| 6 | 43 | Collision Passenger Vessels ICW Passenger Vessel | 4.00 |
| 7 | 9 | Contact Passenger Vessels with Mid-Water Device (<8m below CD) | 3.82 |
| 8 | 7 | Contact Other Vessels with Surface Device | 3.81 |
| 9 | 14 | Contact Other Vessels with Mid-Water Device (<8m below CD) | 3.81 |
| 10 | 31 | Contact Project Vessel with Electrical Hubs | 3.77 |

Table 14-3: Top 10 ranking residual hazards – Operational Phase

| Rank | ID | Hazard Title | Residual Score |
|------|----|--|----------------|
| 1 | 55 | Grounding / Forced Ashore Powered Recreational Vessel | 4.18 |
| 2 | 62 | Swamping / Capsize Un-Powered Recreational Vessel | 4.13 |
| 3 | 37 | Collision Passenger Vessels ICW Passenger Vessel | 4.00 |
| 4 | 8 | Contact Passenger Vessels with Mid-Water Device (<8m below CD) | 3.82 |
| 5 | 30 | Contact Other Vessels with Electrical Hubs | 3.72 |
| 6 | 61 | Swamping / Capsize Powered Recreational Vessel | 3.55 |
| 7 | 10 | Contact Powered Recreational Vessel with Mid-Water Device (<8m below CD) | 3.49 |
| 8 | 46 | Collision Powered Recreational Vessel ICW Powered Recreational Vessel | 3.47 |
| 9 | 32 | Collision Commercial Ship ICW Passenger Vessels | 3.45 |
| 10 | 7 | Contact Commercial Ship with Mid-Water Device (<8m below CD) | 3.20 |

15 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 MDZ.

The approach to cumulative assessment considers the Cumulative Impact Assessment Guidelines issued by RenewableUK in June 2013³⁰.

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 15-1**.

Table 15-1 : 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 |
| Wind Farm | North Hoyle | 81.5 | Operational |
| Aggregate Extraction | Area 457 | 70 | Operational |
| Aggregate Extraction | Area 392 / 393 | 73 | Operational |

³⁰Renewable UK (2013). Cumulative Impact Assessment Guidelines.

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 15-2**.

Table 15-2: 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 15-1**. 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 1**).

Table 15-3: 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 |

15.1 CUMULATIVE ASSESSMENT SUMMARY

The risk as a result of cumulative impacts driven by the proximity of the proposed MDZ to existing projects and associated infrastructure is determined to be low-risk, as outlined within **Table 15-3**. 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.

16 CONCLUSIONS AND RECOMMENDATIONS

This NRA has assessed the baseline and residual navigation risk profiles of both the area encompassing and the proposed MDZ. Changes to navigation risk that may result through the construction and operation of the MDZ have been identified, informed by data analysis and stakeholder feedback and risk assessed. The following conclusions were drawn:

- Generally, vessel traffic levels are low with approximately 8 transits per day through the east-west gate during the summer period. There is little commercial shipping within or close to the MDZ with tankers and large cargo vessels utilising the Off Skerries TSS. The primary large vessels (>3m draught) operating in vicinity of the MDZ are ferries which operate to the north of the MDZ. Fishing is mainly by small vessels and occurs in and around the MDZ, with potting activities close to shore. However, fishing effort is generally low at <20,000 kWh per year. The inshore route is used primarily by small vessels particularly recreational vessels numbers of which increase significantly in summer. Comparatively few small vessels were recorded utilising the western route. The navigation profile as assessed from AIS, RADAR and additional means corroborates the views expressed by stakeholders during consultation with regard to the baseline navigation profile in the area of the MDZ.
- The MDZ lies in an area of challenging metocean conditions and a hazardous lee-shore. The Imray Sailing Directions for Anglesey states that *In the event that there is any sign of a tide race off either Stack it may be advantageous to stand in close to the cliffs and cut through the race as near as possible to the rocks. It may be dangerous to attempt passage round the Stacks, in either direction, in any sort of wind over tide conditions or with winds of Force 5 or greater....In heavy conditions an offing of 7 miles is needed to avoid overfalls and tide races.*³¹ Changes in tidal stream rates and wave heights resulting from the presence of the MDZ were assessed within the HR Wallingford report and identified to have little additional impact over the existing sea conditions.

³¹ Imray Sailing Directions for Anglesey C52 Admiralty 1413 – Anglesey – Holyhead Bay

- The changes introduced to the layout since completion of the 2019 NRA Assessment, primarily:
 - i) the introduction of an area of minimum 8m zone of UKC adjacent to the inshore route (blue area);
 - ii) the introduction of an area of minimum 20m UKC along the northern, west and southern MDZ boundaries (purple area) are assessed to:
 - a) widen the channel to 1,000m reducing the effect of traffic squeezing in the inshore passage and reduces the risks to small vessels presented by the original design, in particular risks associated with grounding / forced ashore (which was scored as significant for recreational vessels within the 2019 NRA) and collision to small vessels (<3m draught).
 - b) increase the area for safe navigation of vessels, particularly of >3m draught including for ferries during both fair and poor weather routing.
- All hazards were assessed to be ALARP or lower in the baseline risk assessment. Of the 85 hazards assessed within the construction phase 19 were scored as ALARP in the baseline assessment. Of the 70 hazards assessed within the operation phase assessment, 6 were scored as ALARP in the baseline assessment.
- A number of risk control measures were suggested to further reduce the risk of hazards scoring ALARP. The most effective mitigation measures against each primary hazard category for hazards scoring ALARP are shown **Table 16-1**. 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) and Resolution A.671(16).

Table 16-1: Suggested Risk Control Measures applicable to hazards scoring ALARP by primary hazard category.

| Hazard Category | 1 - Continuous Monitoring | 2 – Restriction of Navigation | 3 - Designation as No Fishing | 4 - Appropriate alignment and spacing | 5 - Check device surveys | 6 - Guard vessel | 7 - Establish no anchoring areas | 8 - Enhanced cable protection | 9 - Implementation of Safety Zones | 10 - Temporary navigation aids | 11 - Device /Array Specific NRAs | 12 - Provision of life saving equipment | 1 - Minimise use of marker buoys |
|---------------------------|---------------------------|-------------------------------|-------------------------------|---------------------------------------|--------------------------|------------------|----------------------------------|-------------------------------|------------------------------------|--------------------------------|----------------------------------|---|----------------------------------|
| Construction Phase | | | | | | | | | | | | | |
| Contact | | | | | | | | | | | | | |
| Collision | | | | | | | | | | | | | |
| Grounding | | | | | | | | | | | | | |
| Snagging / Obstruction | | | | | | | | | | | | | |
| Swamping / Capsize | | | | | | | | | | | | | |
| Breakout | | | | | | | | | | | | | |
| Operational Phase | | | | | | | | | | | | | |
| Contact | | | | | | N/A | | | N/A | N/A | N/A | | |
| Collision | | | | | | N/A | | | N/A | N/A | N/A | | |
| Grounding | | | | | | N/A | | | N/A | N/A | N/A | | |
| Snagging / Obstruction | | | | | | N/A | | | N/A | N/A | N/A | | |
| Swamping / Capsize | | | | | | N/A | | | N/A | N/A | N/A | | |
| Breakout | | | | | | N/A | | | N/A | N/A | N/A | | |

- With the introduction of the suggested mitigation measures 6 hazards were assessed to be ALARP in the construction phase residual risk assessment and 3 within the operational phase risk assessment. All remaining hazards were assessed to be low or lower.
- 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 a minimum required UKC to be maintained allowing safe transit, marking of devices in accordance with TH requirements will be required in order to mitigate contact hazards. The following points are further noted in this regard:

- i. Marking and lighting is a key mitigation measure embedded within the project of which the details cannot be supplied by Trinity House until a more detailed device specific layout is available. Marking and lighting is assumed to evolve over the life of the project reflecting the phased installation approach. The exact location, number and nature of the marking and navigation buoys will be determined through consultation with Trinity House (TH), the Maritime and Coastguard Agency (MCA) and navigation stakeholders. Further device / array specific risk assessments including NavAids are suggested as the device specific layout develops.
- ii. The restriction of navigation through the gold and green zones is an effective mitigating measure against contact and snagging hazards (**Table 16-1**), however, its adoption will need to be balanced against loss of freedom of navigation by the regulator.
- iii. The restriction of fishing within all zones of the MDZ is an effective mitigation measure against snagging / obstruction including with mooring systems, cables and export cables in addition to contact hazards. This is particularly effective taking into account the worst-case device layout. Its adoption will need to be reviewed by the project in consultation with the MCA and the regulator.
- The presence of devices within the gold and green MDZ zones will impact on vessels running for shelter from the south west. This has been considered as a causal factor within the risk assessment and assessed. Prior to the deployment of any devices an Emergency Response Co-operation Plan (ERCOP) will need to be agreed with the MCA and Trinity House. This will include details of access to a safe havens and places of refuge in the event of an emergency or stress of weather.
- iv. Minimising use of marker buoys within the purple and blue zones is recommended particularly in zones of minimum UKC in order to minimise obstructions and maximise areas of safe navigation.

The Project is therefore assessed to be acceptable in terms of navigational risk assuming compliance with embedded and implementation of suggested additional mitigation measures where appropriate for hazards scoring as ALARP.

Annex A Risk Assessment Methodology

1 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.

2 CONSULTATION

2.1 NATIONAL

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

2.2 LOCAL

Local consultation was undertaken with representatives from the local stakeholder groups outlined in **Table 2-1** in accordance with MGN 543.

Table 2-1: 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) |

3 DATA ANALYSIS

3.1 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 11.2**.

Table 3-1: 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. |

3.2 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.

3.3 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 routeing.

3.4 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.

4 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).

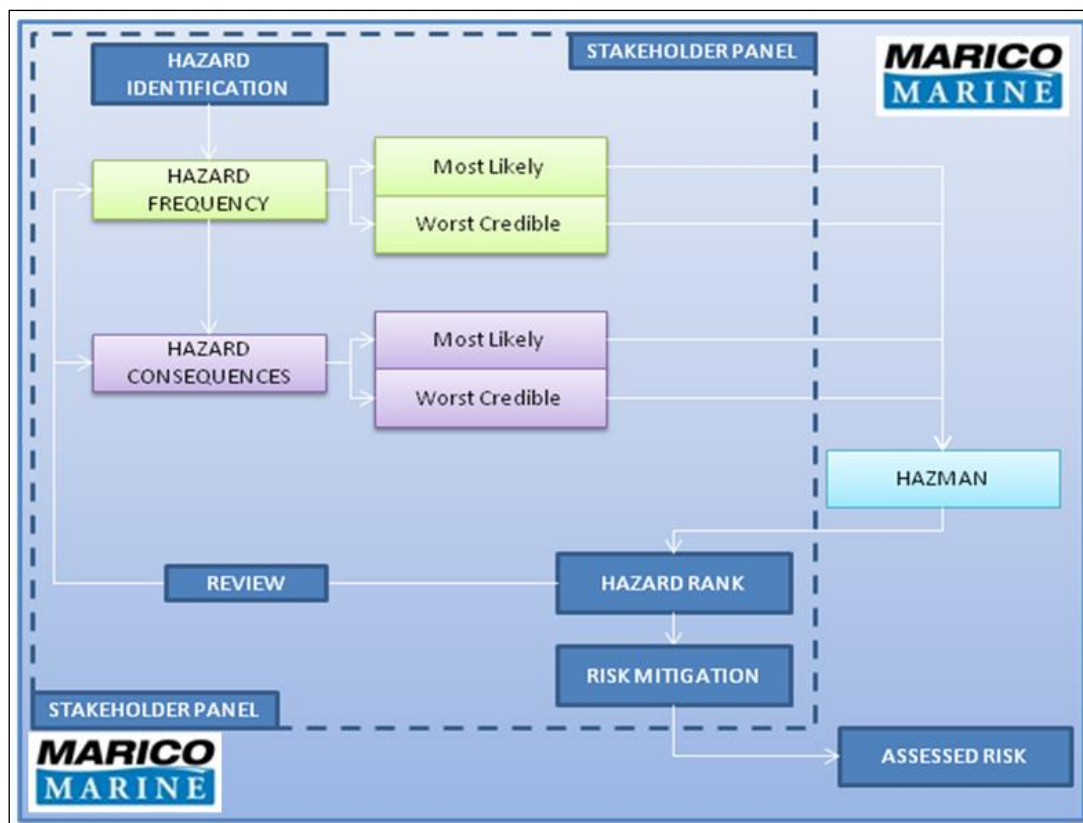
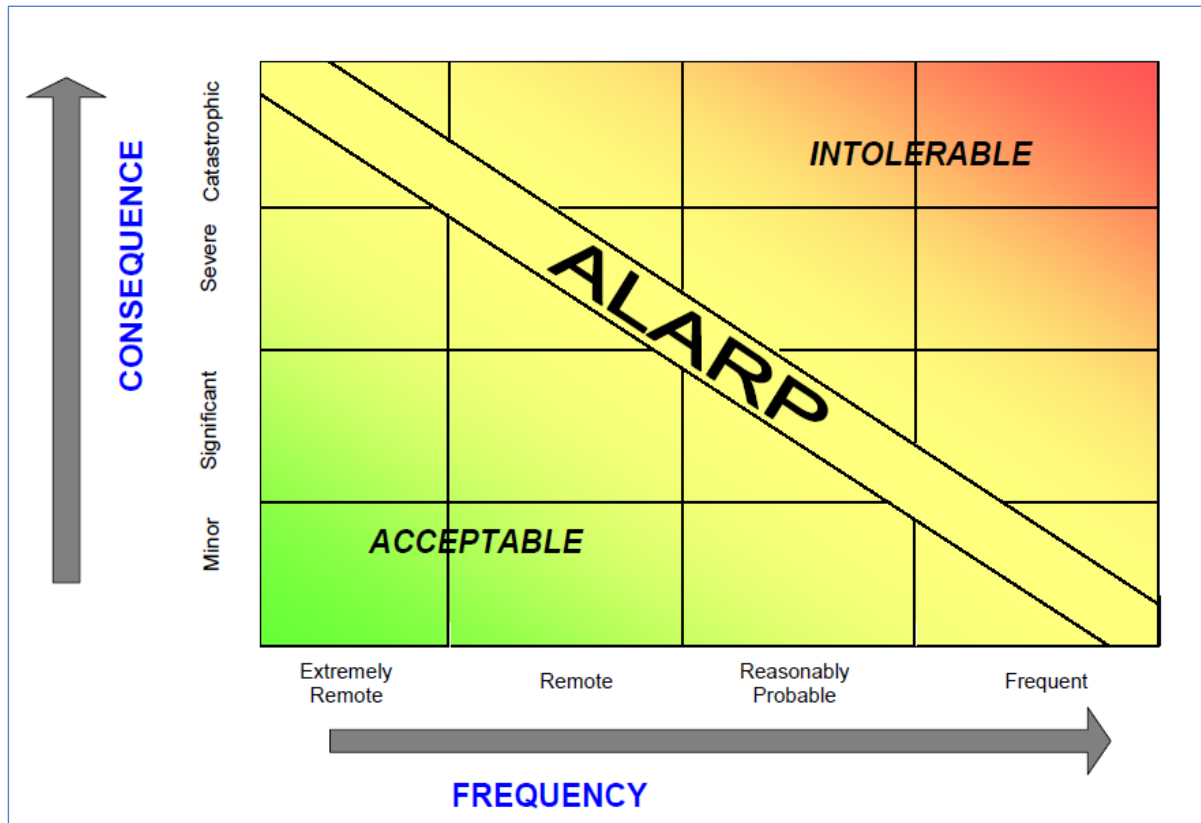


Figure 25: Marico hazard identification and risk assessment process.

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 4-1: 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 4-2: 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 <u>may</u> 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 |
| 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 4-3: Risk factor matrix used for hazard assessment.

| | | | | | | |
|---------------------|------------------|--------------|-----------------|--------------|---------------|--------|
| Consequences | Cat 5 | 5 | 6 | 7 | 8 | 10 |
| | 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:

| <i>Risk Number</i> | <i>Risk</i> |
|--------------------|---------------------------------------|
| 0 to 1.9 | <i>Negligible</i> |
| 2 to 3.9 | <i>Low Risk</i> |
| 4 to 6.9 | <i>As Low as Reasonably Practical</i> |
| 7 to 8.9 | <i>Significant Risk</i> |
| 9 to 10.0 | <i>High Risk</i> |

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 | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|--|---|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 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 / safe haven 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 2.58 |
| 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 / safe haven 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 | 2 | 3 | 4 | 2 | 4 | 1 | 2.49 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 2.49 |
| 3 | Contact Project Vessel with Surface Device | A project vessel contacts with the device | Construction vessel inadvertently contacts surface device during installation; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; 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; Tier 1 to Tier 2 Spill Criteria, small operational oil spill;; Temporary closure / prolonged restrictions on operations. | 1 | 2 | 1 | 2 | 5 | 3 | 4 | 2 | 4 | 2 | 4.38 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 3.47 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|---|---|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 4 | Contact Fishing Vessel with Surface Device | A fishing vessel contacts with the device | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 2.5 | 3.47 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green Morlais Zones; MDZ designation as no fishing zone; Appropriate spacing of devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Provision of life saving equipment on fixed structures and floating devices. | 2.86 |
| 5 | Contact Powered Recreational Vessel with Surface Device | A powered recreational vessel contacts with the device | Construction vessel contacts device during installation; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 4.5 | 4 | 3 | 1 | 2 | 3 | 3.94 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 2.76 |
| 6 | Contact Un-Powered Recreational Vessel with Surface Device | An unpowered recreational vessel contacts with the device | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Set on to device / pinned by tidal stream; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Implementation of Safety Zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 2.76 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|--|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 7 | Contact Other Vessels with Surface Device | Small vessel (including maintenance Vessel) contacts the device | Construction vessel working on device makes inadvertent contact; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; running for shelter / safe haven in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 the Gold and Green MDZ Zones; Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices. Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 3.81 |
| 8 | 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 / safe haven in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; 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. | Heavy contact; 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 the gold and green MDZ zones; Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 3.20 |
| 9 | 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 / safe haven in poor weather; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; 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. | Heavy contact; 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 | 3.5 | 3 | 4 | 2 | 4 | 2 | 4.06 | Restrict Navigation through the gold and green MDZ zones; Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 3.82 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|---|---|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 10 | Contact Project Vessel with Mid-Water Device (<8m below CD) | A Project Vessel contacts the device | A construction vessel inadvertently makes contact with the device during installation; 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; Partially constructed device not visible. | Light contact; No Injury / Possible very minor injury; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Temporary suspension of operations and prolonged restrictions. | Heavy contact; Multiple minor or single major injury; Major damage to vessel; Tier 1 to Tier 2 Spill Criteria, small operational oil spill; Temporary closure / prolonged restrictions on operations. | 1 | 3 | 1 | 3 | 5 | 3 | 4 | 2 | 4 | 2 | 5.28 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Check device surveys; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 4.38 |
| 11 | Contact Fishing Vessel with Mid-Water Device <8m below CD) | A fishing vessel contacts with the device | Insufficient Lookout; Poor passage planning; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter / safe haven in poor weather; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue. | Heavy contact, person in water, entanglement with device or moorings; 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 | 4.5 | 4 | 3 | 1 | 3 | 4 | 5.00 | Restrict navigation through the gold and green MDZ zones; Continuous Monitoring by Marine Co-ordination Centre; MDZ designation as No Fishing Zone; Check Device Surveys; Appropriate alignment and spacing of arrays and devices; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Undertake device / array specific risk assessments to include NavAids; Temporary navigation aids as required by Trinity House; Provision of life saving equipment on fixed structures and floating devices. | 3.02 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|--|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 12 | Contact Powered Recreational Vessel with Mid-Water Device (<8m below CD) | A powered recreational vessel contacts with the device | Insufficient Lookout; Poor passage planning; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter / safe haven in poor weather; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; Multiple minor or single major injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 4 | 4 | 3 | 1 | 3 | 3 | 4.47 | Restrict navigation through the gold and green MDZ zones; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Appropriate alignment and spacing of arrays and devices; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 3.49 |
| 13 | Contact Un-Powered Recreational Vessel with Mid-Water Device (<8m below CD) | An un-powered recreational vessel contacts with the device | Insufficient Lookout; Poor passage planning; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Set on to device by tidal stream; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter / safe haven in poor weather; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; Single minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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. | 2 | 1 | 1 | 1 | 3.5 | 4 | 2 | 1 | 3 | 3 | 3.18 | Restrict navigation through the gold and green MDZ zones; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Appropriate alignment and spacing of arrays and devices; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Undertake device / array specific risk assessments to include NavAids; Temporary navigation aids as required by Trinity House; Provision of life saving equipment on fixed structures and floating devices. | 2.61 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|---|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 14 | Contact Other Vessels with Mid-Water Device (<8m below CD) | Maintenance Vessel contacts with the device | Construction vessel contacts device during installation; Insufficient Lookout; Poor passage planning; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Devices not visible; Running for shelter / safe haven in poor weather; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue. | Heavy contact, person in the water; 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 | 1 | 1 | 2 | 5 | 4 | 4 | 1 | 3 | 3 | 4.72 | Restrict Navigation through the Gold and Green MDZ Zones; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Appropriate alignment and spacing of arrays and devices; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 3.81 |
| 15 | 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 / safe haven in poor weather; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; 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. | Heavy Contact, person in the water; 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 the Gold and Green MDZ Zones; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Minimise use of marker buoys in zones of minimum UKC. | 2.88 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|--|--|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 16 | 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 / safe haven in poor weather; Device not at stated depth; Lack of knowledge of construction progress / device locations; Partially constructed device not visible. | Light contact; 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. | Heavy contact; 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 | 2 | 3 | 4 | 2 | 4 | 1 | 3.11 | Restrict Navigation through the Gold and Green MDZ Zones; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Minimise use of marker buoys in zones of minimum UKC. | 3.11 |
| 17 | Contact Project Vessel with Mid-Water Device (>8m below CD) | A project vessel makes contact with the device | A construction vessel inadvertently makes contact with the device during installation; 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; Partially constructed device not visible. | Light contact; 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. | Heavy Contact, person in the water; 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 | 2 | 3 | 4 | 2 | 4 | 1 | 3.11 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Check device surveys; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 3.11 |
| 18 | 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 | 0.00 |
| 19 | Contact Powered Recreational Vessel with Mid-Water Device (>8m below CD) | A powered 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 | 0.00 |
| 20 | Contact Un-Powered Recreational Vessel with Mid-Water Device (>8m below CD) | An un-powered 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 | 0.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|---|---|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 21 | 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 | 0.00 |
| 22 | Contact Commercial Ship with Sea-Bed Device >20m UKC | A deep draught 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 / safe haven in poor weather; Device not at stated depth; Lack of knowledge of construction progress / device locations. | Light contact; 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. | Heavy Contact, person in the water; 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 the Gold and Green MDZ Zones; Continuous Monitoring by Marine Co-ordination Centre; Check Device Surveys; Implementation of Safety Zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Minimise use of marker buoys in zones of minimum UKC. | 2.88 |
| 23 | 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 | 0.00 |
| 24 | Contact Project Vessel with Sea-Bed Device >20m UKC | A Project Vessel contacts the device | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | N/A | 0.00 |
| 25 | 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 | 0.00 |
| 26 | Contact Powered Recreational Vessel with Sea-Bed Device >20m UKC | A powered 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 | 0.00 |
| 27 | Contact Un-Powered Recreational Vessel with Sea-Bed Device >20m UKC | An un-powered 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 | 0.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|---|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 28 | 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 | 0.00 |
| 29 | Contact Commercial Ship with Electrical Hubs | Commercial vessel makes contact with fixed electrical hub. | Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Electrical hub present in zone of 20m minimum UKC. | 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 | 1 | 3 | 4 | 3 | 4 | 1 | 2.45 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 2.45 |
| 30 | Contact Passenger Vessels with Electrical Hubs | Passenger vessel makes contact with fixed electrical hub. | Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Electrical hub present in zone of 20m minimum UKC. | 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. | 2 | 2 | 1 | 2 | 3 | 4 | 4 | 2 | 4 | 1 | 2.94 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 2.68 |
| 31 | Contact Project Vessel with Electrical Hubs | A Project Vessel makes contact with a fixed electrical hub | A construction vessel inadvertently makes contact with the electrical hub during installation; Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Partially constructed electrical hub not visible. | Single 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. | 2 | 2 | 1 | 2 | 4 | 4 | 4 | 2 | 4 | 2 | 3.77 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 3.77 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|--|---|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 32 | Contact Fishing Vessel with Electrcial Hubs | A fishing vessel makes contact with fixed electrical hub. | Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 3.5 | 4 | 3 | 1 | 2 | 2 | 2.93 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; MDZ designation as No Fishing Zone; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 2.54 |
| 33 | Contact Powered Recreational Vessel with Electrcial Hubs | A powered recreational vessel makes contact with a fixed electrical hub. | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 3.5 | 4 | 3 | 1 | 2 | 2 | 2.93 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Construction vessels to be marked in accordance with COLREGs; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 2.76 |
| 34 | Contact Un-Powered Recreational Vessel with Electrcial Hubs | An un-powered recreational vessel makes contact with a fixed electrical hub. | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Set on to device by tidal stream; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather | Light contact; Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | 2 | 1 | 1 | 1 | 2 | 4 | 2 | 1 | 1 | 1 | 1.94 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Construction vessels to be marked in accordance with COLREGs; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 1.94 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|--|---|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 35 | Contact Other Vessels with Electrcial Hubs | Small vessel (including construction vessel) makes contact with a fixed electrical device. | Construction vessels contacts electrical hub during installation; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 4.5 | 4 | 3 | 1 | 3 | 3 | 4.07 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Construction vessels to be marked in accordance with COLREGs; Undertake device / array specific risk assessments to include NavAids; Provision of life saving equipment on fixed structures and floating devices. | 4.07 |
| 36 | Collision Commercial Ship ICW Commercial Ship | Two commercial vessels collide due to the presence of the devices. | Increased traffic density to the north and west due to avoidance of the MDZ; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.54 |
| 37 | Collision Commercial Ship ICW Passenger Vessels | A commercial vessel collides with a passenger vessel due to the presence of the devices | Increased traffic density to the north due to avoidance of the MDZ; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 3.45 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|--|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 38 | Collision Commercial Ship ICW Project Vessel | A commercial vessel collides with a project vessel | Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid 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 major injuries or single fatality; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations. | 3 | 2 | 1 | 3 | 1 | 4 | 4 | 3 | 4 | 1 | 3.13 | Continuous Monitoring by Marine Co-ordination Centre; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 3.13 |
| 39 | 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; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.27 |
| 40 | Collision Commercial Ship ICW Powered Recreational Vessel | A commercial vessel collides with a powered 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 / construction activities and associated vessels. | 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.72 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|--|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 41 | Collision Commercial Ship ICW Un-Powered Recreational Vessel | A commercial vessel collides with an un-powered recreational vessel due to the presence of the devices | Insufficient Lookout; Human Error; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.72 |
| 42 | 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; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.27 |
| 43 | Collision Passenger Vessels ICW Passenger Vessel | A passenger vessel collides with a passenger vessel due to the presence of the devices | Increased traffic density to the north due to avoidance of the MDZ; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 4.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|---|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 44 | Collision Passenger Ship ICW Project Vessel | A passenger vessel collides with a project vessel | A ferry collides with a construction vessel carrying out construction activities in the north of the MDZ; Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid 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 major injuries or single fatality; Major damage to vessel; Pollution limited to immediate area - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations. | 3 | 2 | 1 | 3 | 2 | 5 | 4 | 3 | 4 | 1 | 3.71 | Continuous Monitoring by Marine Co-ordination Centre; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids. | 3.71 |
| 45 | 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; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.34 |
| 46 | Collision Passenger Vessels ICW Powered Recreational Vessel | A passenger vessel collides with a powered recreational vessel due to the presence of the devices | Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.82 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|---|---|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 47 | Collision Passenger Vessels ICW Un-Powered Recreational Vessel | A passenger vessel collides with an un-powered recreational vessel due to the presence of the devices | Insufficient Lookout; Human Error; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.96 |
| 48 | 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; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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; Appropriate alignment and spacing of arrays and devices; Implementation of safety zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.43 |
| 49 | Collision Project Vessel ICW Project Vessel | A project vessel collides with a project vessel | A project vessel collides with another project vessel while undertaking construction activities; Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid 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 short term loss of revenue. | Multiple major injuries or single fatality; Major damage to vessel; Tier 1 - Tier 2 Spill Criteria; Temporary closure / prolonged restrictions on operations. | 3 | 2 | 1 | 2 | 4 | 4 | 4 | 2 | 4 | 2 | 4.53 | Continuous Monitoring by Marine Co-ordination Centre; Temporary navigation aids as required by Trinity House. | 4.53 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|--|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 50 | Collision Project Vessel ICW Fishing Vessel | A project vessel collides with a fishing vessel | Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid 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; Restrict navigation through the gold and green MDZ zones; MDZ designation as a no fishing zone; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Minimise use of marker buoys in zones of minimum UKC. | 2.43 |
| 51 | Collision Project Vessel ICW Powered Recreational Vessel | A project vessel collides with a powered recreational vessel | Insufficient Lookout; Poor passage planning; Insufficient planning and individual risk assessment prior to departure; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Set on to construction activities as a result of tidal stream; 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; Moderate damage to vessel; Negligible effect upon the Environment / No pollution; Moderate impact, temporary suspension of operations or prolonged restrictions on operations. | 2 | 2 | 1 | 2 | 3 | 4 | 3 | 1 | 3 | 2 | 3.02 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through the gold and green MDZ zones; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Minimise use of marker buoys in zones of minimum UKC. | 2.76 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|--|---|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 52 | Collision Project Vessel ICW Un-Powered Recreational Vessel | A project vessel collides with an un-powered recreational vessel | Insufficient Lookout; Poor passage planning; Insufficient planning and individual risk assessment prior to departure; Human Error; Equipment Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Set on to construction activities / pinned as a result of tidal stream; 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; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Moderate impact, temporary suspension of operations or prolonged restrictions on operations. | 2 | 2 | 1 | 2 | 2 | 4 | 2 | 1 | 3 | 2 | 2.66 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through the gold and green MDZ zones; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Minimise use of marker buoys in zones of minimum UKC. | 2.66 |
| 53 | Collision Project Vessel ICW Other Vessel | A project vessel collides with an other vessel | Project vessel collides with small workboat / construction vessel while undertaking construction activities; Insufficient Lookout; Poor passage planning; Human Error; Equipment or Mechanical Failure; Navigational Aid 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; Moderate impact on operations, temporary suspension or prolonged restrictions. | 2 | 2 | 1 | 2 | 5 | 4 | 4 | 1 | 3 | 2 | 4.63 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through the gold and green MDZ zones; Appropriate alignment and spacing of devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Undertake device / array specific risk assessments to include NavAids; Minimise use of marker buoys in zones of minimum UKC. | 3.57 |
| 54 | Collision Fishing Vessel ICW Fishing Vessel | A fishing vessel collides with a fishing vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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 | 2 | 4 | 3 | 1 | 2 | 1.5 | 2.38 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Construction vessels to be marked in accordance with COLREGS; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.38 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|---|--|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 55 | Collision Fishing Vessel ICW Powered Recreational Vessel | A fishing vessel collides with a recreational vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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 | 2.5 | 4 | 3 | 1 | 3 | 2 | 3.31 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.99 |
| 56 | Collision Fishing Vessel ICW Un-Powered Recreational Vessel | A fishing vessel collides with an un-recreational vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | Multiple minor or single major injury; Negligible 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 | 1 | 1 | 1 | 3 | 4 | 2 | 1 | 3 | 3 | 3.67 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.78 |
| 57 | Collision Fishing Vessel ICW Other Vessels | A fishing vessel collides with an other vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Implementation of safety zones; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.76 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|---|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 58 | Collision Powered Recreational Vessel ICW Powered Recreational Vessel | A recreational vessel collides with a recreational vessel due to the presence of the devices | Narrowing of the inshore route during construction activities; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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 | 3.5 | 4 | 3 | 1 | 3 | 3 | 4.35 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 3.64 |
| 59 | Collision Powered Recreational Vessel ICW Un-Powered Recreational Vessel | A powered recreational vessel collides with an un-recreational vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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. | 2 | 1 | 1 | 1 | 3.5 | 4 | 2 | 1 | 3 | 3 | 3.18 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.61 |
| 60 | Collision Powered Recreational Vessel ICW Other Vessel | A recreational vessel collides with an other vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 3.49 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|---|--|--|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 61 | Collision Un-Powered Recreational Vessel ICW Un-Powered Recreational Vessel | An un-powered recreational vessel collides with un-powered recreational vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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. | 1 | 1 | 1 | 1 | 5 | 4 | 1 | 1 | 3 | 3 | 2.13 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.00 |
| 62 | Collision Un-Powered Recreational Vessel ICW Other Vessel | A un-powered recreational vessel collides with an other vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | Multiple minor or single major injury; Negligible 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 | 1 | 1 | 1 | 3 | 4 | 2 | 1 | 3 | 2 | 3.24 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 2.94 |
| 63 | Collision Other Vessels ICW Other Vessels | An other vessel collides with an other vessel due to the presence of the devices. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | 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 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Implementation of safety zones; Temporary navigation aids as required by Trinity House; Minimise use of marker buoys in zones of minimum UKC. | 3.59 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|---|---|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 64 | Grounding / Forced Ashore 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 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |
| 65 | Grounding / Forced Ashore 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 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |
| 66 | Grounding / Forced Ashore Project Vessels | A project vessel runs aground | While undertaking construction activities in vicinity of inshore route; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels. | Grounding with little damage; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Forced ashore onto rocks / cliffs; Multiple major injuries or a single fatality; Major damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Major impact upon operations, temporary closure or prolonged restrictions. | 2 | 2 | 1 | 1 | 2 | 4 | 4 | 2 | 4 | 1 | 2.57 | Continuous Monitoring by Marine Co-ordination Centre; Temporary navigation aids as required by Trinity House. | 2.57 |
| 67 | Grounding / Forced Ashore Fishing Vessel | A fishing vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels; Avoidance of safety zones. Running for shelter / safe haven in poor weather. | Grounding with little damage; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Forced ashore onto rocks / cliffs; 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device/ array specific risk assessment to include NavAids and marker buoys; Minimise use of marker buoys in zones of minimum UKC. | 2.88 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 68 | Grounding / Forced Ashore Powered Recreational Vessel | A recreational vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels; Avoidance of safety zones; Running for shelter / safe haven in poor weather. | Grounding with little damage; 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. | Forced ashore onto rocks / cliffs; 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 | 4 | 5 | 3 | 2 | 4 | 3 | 5.27 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device/ array specific risk assessment to include NavAids and marker buoys; Minimise use of marker buoys in zones of minimum UKC. | 4.93 |
| 69 | Grounding / Forced Ashore Un-Powered Recreational Vessel | An un-powered recreational vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels; Avoidance of safety zones; Running for shelter / safe haven in poor weather. | Grounding with little damage; Single minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Forced ashore onto rocks / cliffs; Multiple fatalities; Moderate damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Moderate impact upon operations / temporary suspension or prolonged restrictions. | 2 | 1 | 1 | 1 | 4.5 | 4 | 2 | 1 | 3 | 3 | 3.67 | Continuous Monitoring by Marine Co-ordination Centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device/ array specific risk assessment to include NavAids and marker buoys; Minimise use of marker buoys in zones of minimum UKC. | 3.37 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 70 | Grounding / Forced Ashore Other Vessel | An other vessel / contacts seabed, rocks or cliff grounds due to the presence of the devices and their moorings. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel / construction activities and associated vessels; Avoidance of safety zones; Running for shelter / safe haven in poor weather. | Grounding with little damage; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Forced ashore onto rocks / cliffs; 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; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Temporary navigation aids as required by Trinity House; Undertake device/ array specific risk assessment to include NavAids and marker buoys; Minimise use of marker buoys in zones of minimum UKC. | 3.34 |
| 71 | Swamping / Capsize Commercial Ship | A commercial vessel swamps / capsizes due to the presence of the devices and their moorings. | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |
| 72 | Swamping / Capsize Passenger Vessels | A passenger vessel swamps / capsizes due to the presence of the devices and their moorings. | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |
| 73 | Swamping / Capsize Project Vessels | A project vessel swamps / capsizes due to the presence of the devices and their moorings. | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|---|---|---|--------------------------------|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 74 | Swamping / Capsize Fishing Vessel | A fishing vessel overwhelmed by sea and swamps / capsizes due to the presence of the devices and their moorings. | Narrowing of the inshore route; Human Error; Overloading; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Avoidance of other vessel / construction activities and associated vessels; Avoidance of safety zones; Running for shelter / safe haven in poor weather. | Vessel filled with water but does not sink; | Vessel lost, persons in water; | 2 | 2 | 1 | 2 | 3 | 4 | 3 | 2 | 3 | 2 | 3.13 | Continuous monitoring by marine coordination centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Provision of life saving equipment on fixed structures and floating devices; Minimise use of marker buoys in zones of minimum UKC. | 3.13 |
| 75 | Swamping / Capsize Powered Recreational Vessel | A powered recreational vessel overwhelmed by sea and swamps / capsizes due to the presence of the devices and their moorings. | Narrowing of the inshore route; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Avoidance of other vessel / construction activities and associated vessels; Avoidance of safety zones; Running for shelter / safe haven in poor weather. | Vessel filled with water but does not sink; | Vessel lost, persons in water; | 2 | 2 | 1 | 2 | 3 | 5 | 3 | 2 | 4 | 2 | 3.55 | Continuous monitoring by marine coordination centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Provision of life saving equipment on fixed structures and floating devices; Minimise use of marker buoys in zones of minimum UKC. | 3.18 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|---|---|---|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 76 | Swamping / Capsize Un-Powered Recreational Vessel | An un-powered recreational vessel overwhelmed by sea and swamps / capsizes due to the presence of the devices and their moorings. | Narrowing of the inshore route; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Avoidance of other vessel / construction activities and associated vessels; Avoidance of safety zones; Running for shelter / safe haven in poor weather. | Vessel filled with water but does not sink; | Vessel lost, persons in water; | 2 | 1 | 1 | 1 | 5 | 4 | 2 | 1 | 3 | 3 | 4.13 | Continuous monitoring by marine coordination centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Provision of life saving equipment on fixed structures and floating devices; Minimise use of marker buoys in zones of minimum UKC. | 4.13 |
| 77 | Swamping / Capsize Other Vessel | An other vessel overwhelmed by sea and swamps / capsizes due to the presence of the devices and their moorings. | Narrowing of the inshore route; Human Error; Overloading; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Avoidance of other vessel / construction activities and associated vessels; Avoidance of safety zones; Running for shelter / safe haven in poor weather. | Vessel filled with water but does not sink; | Vessel lost, persons in water; | 2 | 2 | 1 | 2 | 3 | 4 | 3 | 2 | 3 | 3 | 3.62 | Continuous monitoring by marine coordination centre; Appropriate alignment and spacing of arrays and devices; Guard vessel to monitor passing traffic; Provision of life saving equipment on fixed structures and floating devices; Minimise use of marker buoys in zones of minimum UKC. | 3.62 |
| 78 | Snagging/ Obstruction Commercial Ship | A commercial vessel's anchor interacts with a cable or the device and its moorings. | Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Insufficient cable protection; Adverse Environmental Conditions; Poor Visibility; Running for shelter / safe haven in poor weather. Navigation aid failure. | Anchor snags mooring lines or power cables but cleared on weighing anchor; 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. | Anchor snags mooring lines or power cables but cannot be cleared on weighing anchor seriously damaging moorings, devices or power cables; 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; Restrict navigation through gold and green MDZ zones; Establish no anchoring areas; Enhanced cable protection. | 1.74 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|--|--|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 79 | Snagging/ Obstruction Passenger Vessels | A ferry's anchor interacts with a device, its moorings or a cable. | Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Insufficient cable protection; Adverse Environmental Conditions; Poor Visibility; Running for shelter / safe haven in poor weather. Navigation aid failure. | Anchor snags mooring lines or power cables but cleared on weighing; 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. | Anchor snags mooring lines or power cables but cannot be cleared on weighing seriously damaging moorings, devices or power cables; 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; Restrict navigation through gold and green MDZ zones; Establish no anchoring areas; Enhanced cable protection. | 1.85 |
| 80 | Snagging / Obstruction Project Vessels | A project vessels anchor interacts with a device, its moorings or a cable. | Construction vessel snags cable while undertaking installation activities; Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Insufficient cable protection; Adverse Environmental Conditions; Poor Visibility; Running for shelter / safe haven in poor weather. Navigation aid failure. | Anchor snags mooring lines or power cables but cleared; 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. | Anchor snags mooring lines or power cables but cannot be cleared seriously damaging moorings or power cables; Multiple minor injuries or a single major; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Temporary closure or prolonged restrictions on project operations. | 1 | 1 | 1 | 2 | 5 | 3 | 2 | 1 | 4 | 3 | 4.13 | Continuous Monitoring by Marine Co-ordination Centre; Establish no anchoring areas; Enhanced cable protection. | 3.37 |
| 81 | Snagging/ Obstruction Fishing Vessel | A fishing vessel's gear/ anchor interacts with a cable or the device and its moorings. | Fishing gear snags moorings, device or power cable; Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Insufficient cable protection; Adverse Environmental Conditions; Poor Visibility; Running for shelter / safe haven in poor weather. Navigation aid failure. | Fishing gear or anchor snags mooring lines or power cables but cleared; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Fishing gear or anchor snags mooring lines or power cables but cannot be cleared seriously damaging moorings, devices or power cables; 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 | 3 | 4.50 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through gold and green MDZ zones; MDZ designation as no fishing zone; Establish no anchoring areas; Enhanced cable protection. | 2.76 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Risk Controls | Residual Risk Score |
|----|--|---|---|--|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 82 | Snagging/ Obstruction Powered Recreational Vessel | A recreational vessel's gear/ anchor interacts with a cable or the device and its moorings. | Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Insufficient cable protection; Adverse Environmental Conditions; Poor Visibility; Running for shelter / safe haven in poor weather. Navigation aid failure. | Anchor snags mooring lines or power cables but cleared; No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Anchor snags mooring lines or power cables but cannot be cleared seriously damaging moorings, devices or power cables; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through gold and green MDZ zones; Establish no anchoring areas; Enhanced cable protection; Minimise use of marker buoys in zones of minimum UKC. | 0.56 |
| 83 | Snagging/ Obstruction Un-Powered Recreational Vessel | An un-powered recreational vessel's gear/ anchor interacts with a cable, the device, marker buoy or its moorings. | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |
| 84 | Snagging/ Obstruction Other Vessel | An other vessel's gear/anchor interacts with a cable or the device and its moorings. | Construction vessel inadvertently snags mooring lines or power cables during works; Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Insufficient cable protection; Adverse Environmental Conditions; Poor Visibility; Running for shelter / safe haven in poor weather. Navigation aid failure. | Anchor snags mooring lines or power cables but cleared; No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Anchor snags mooring lines or power cables but cannot be cleared seriously damaging moorings, devices or power cables; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through gold and green MDZ zones; Establish no anchoring areas; Enhanced cable protection. | 3.36 |
| 85 | Breakout of device / device not at stated depth | The device's moorings fail, device becomes a hazard to navigation. | Equipment / mooring failure; Adverse Environmental Conditions; Breaks adrift during deployment operations; Device or its mooring lines hit / snagged by vessel. | Mooring failure, device remains in position and at stated depth; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Mooring failure, device breaks free or no longer at stated depth / required UKC and becomes contact hazard. 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 gold and green MDZ zones; Continuous Monitoring by Marine Co-ordination Centre; Check device surveys; Establish no anchoring areas; Implementation of safety zones; Temporary navigation aids as required by Trinity House. | 2.40 |

Annex C Hazard Log – Operational Phase

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|---|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 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 / safe haven 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; | 2.58 |
| 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 / safe haven 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 | 2 | 3 | 4 | 2 | 4 | 1 | 2.49 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; | 2.49 |
| 3 | Contact Fishing Vessel with Surface Device | A fishing vessel contacts with the device | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 2.5 | 3.47 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; MDZ designation as No Fishing Zone; Appropriate alignment and spacing of arrays and devices; Provision of life saving equipment on fixed structures and floating devices. | 2.86 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|--|---|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 4 | Contact Powered Recreational Vessel with Surface Device | A powered recreational vessel contacts with the device | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Provision of life saving equipment on fixed structures and floating devices. | 2.76 |
| 5 | Contact Un-Powered Recreational Vessel with Surface Device | A non-powered recreational vessel contacts with the device | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Set on to device / pinned by tidal stream; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Provision of life saving equipment on fixed structures and floating devices. | 2.76 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|--|---|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 6 | Contact Other Vessels with Surface Device | Small vessel (including maintenance Vessel) contacts with the device | Maintenance vessel working on device makes inadvertent contact; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 2.5 | 3.56 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Provision of life saving equipment on fixed structures and floating devices. | 2.95 |
| 7 | 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 / safe haven in poor weather; Device not at stated depth. | Light contact; 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. | Heavy contact; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Check device surveys. | 3.20 |
| 8 | 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 / safe haven in poor weather; Device not at stated depth. | Light contact; 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. | Heavy contact; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Check device surveys. | 3.82 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|--|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 9 | Contact Fishing Vessel with Mid-Water Device <8m below CD) | A fishing vessel contacts with the device | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Device not at stated depth. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue. | Heavy contact, person in water, entanglement with device or moorings. 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 | 4 | 4 | 3 | 1 | 3 | 3.5 | 4.23 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; MDZ designation as No Fishing Zone; Appropriate alignment and spacing of arrays and devices; Check device surveys; Provision of life saving equipment on fixed structures and floating devices. | 3.02 |
| 10 | Contact Powered Recreational Vessel with Mid-Water Device (<8m below CD) | A powered recreational vessel contacts with the device | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Device not at stated depth. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 3 | 3.5 | 4.01 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Check device surveys; Provision of life saving equipment on fixed structures and floating devices. | 3.49 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|---|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 11 | Contact Un-Powered Recreational Vessel with Mid-Water Device (<8m below CD) | An un-powered recreational vessel contacts with the device | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Set on to device by tidal stream; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Device not at stated depth. | Light contact; Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Moderate impact upon operations / temporary suspension or prolonged restrictions. | 2 | 1 | 1 | 1 | 3 | 4 | 2 | 1 | 3 | 3 | 3.04 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Check device surveys; Provision of life saving equipment on fixed structures and floating devices. | 3.07 |
| 12 | Contact Other Vessels with Mid-Water Device (<8m below CD) | Maintenance Vessel contacts with the device | Maintenance vessel working on device makes inadvertent contact; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Device not at stated depth. | Light contact; Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue. | Heavy contact, person in water; 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 | 1 | 1 | 2 | 3.5 | 4 | 4 | 1 | 3 | 3 | 3.57 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Appropriate alignment and spacing of arrays and devices; Check device surveys; Provision of life saving equipment on fixed structures and floating devices. | 2.95 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|--|---|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 13 | 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 / safe haven in poor weather; Device not at stated depth. | Light contact; 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. | Heavy contact; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Check device surveys; Minimise use of marker buoys in zones of minimum UKC. | 2.88 |
| 14 | 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 / safe haven in poor weather; Device not at stated depth. | Light contact; 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. | Heavy contact; 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 | 2 | 3 | 4 | 2 | 4 | 1 | 3.11 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Check device surveys; Minimise use of marker buoys in zones of minimum UKC. | 3.11 |
| 15 | 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 | 0.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|-----------------|---------------------|------------------------|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 16 | Contact Powered Recreational Vessel with Mid-Water Device (>8m below CD) | A powered 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 | 0.00 |
| 17 | Contact Un-Powered Recreational Vessel with Mid-Water Device (>8m below CD) | An un-powered recreational vessel contacts with the device | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | | 0.00 |
| 18 | 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 | 0.00 |
| 19 | 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 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | N/A | 0.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|-----------------|---------------------|------------------------|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 20 | 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 | 0.00 |
| 21 | 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 | 0.00 |
| 22 | Contact Powered Recreational Vessel with Sea-Bed Device >20m UKC | A powered 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 | 0.00 |
| 23 | Contact Un-Powered Recreational Vessel with Sea-Bed Device >20m UKC | An un-powered recreational vessel contacts with the device | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | | 0.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|--|--|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 24 | 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 | 0.00 |
| 25 | Contact Commercial Vessel with Electrical Hubs | Commercial vessel makes contact with fixed electrical hub. | Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Electrical hub present in zone of 20m minimum UKC. | Minor contact; No Injury / Possible very minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations. | Heavy contact; 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 | 1 | 3 | 4 | 3 | 4 | 1 | 2.45 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones. | 2.45 |
| 26 | Contact Passenger Vessels with Electrical Hubs | Passenger vessel makes contact with fixed electrical hub. | Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather; Electrical hub present in zone of 20m minimum UKC. | Light contact; 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. | Heavy contact; 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. | 2 | 2 | 1 | 2 | 2 | 4 | 4 | 2 | 4 | 1 | 2.68 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones. | 2.68 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|---|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 27 | Contact Fishing Vessel with Electrical Hubs | A fishing vessel makes contact with fixed electrical hub. | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather. | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 3 | 4 | 3 | 1 | 3 | 2 | 2.86 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; MDZ designation as No Fishing Zone; Provision of life saving equipment on fixed structures and floating devices. | 2.65 |
| 28 | Contact Powered Recreational Vessel with Electrical Hubs | A powered recreational vessel makes contact with a fixed electrical hub. | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Provision of life saving equipment on fixed structures and floating devices. | 2.76 |
| 29 | Contact Un-Powered Recreational Vessel with Electrical Hubs | An un-powered recreational vessel makes contact with a fixed electrical hub. | Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Set on to device by tidal stream; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather | Light contact; Minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; Multiple major injuries or a single fatality; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | 2 | 1 | 1 | 1 | 2 | 4 | 2 | 1 | 1 | 1 | 1.94 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Provision of life saving equipment on fixed structures and floating devices. | 1.94 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|---|--|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 30 | Contact Other Vessels with Electrical Hubs | Small vessel (including maintenance Vessel) contacts with the device | Workboat undertaking Maintenance on hub makes inadvertent contact; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Navigational Aid Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather | Light contact; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Heavy contact, person in the water; 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 | 3 | 1 | 3 | 3 | 3.72 | Continuous Monitoring by Marine Co-ordination Centre; Restrict Navigation through the Gold and Green MDZ Zones; Provision of life saving equipment on fixed structures and floating devices. | 3.72 |
| 31 | Collision Commercial Ship ICW Commercial Ship | Two commercial vessels collide due to the presence of the devices. | Increased traffic density to the north due to avoidance of the MDZ; 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 | Minimise use of marker buoys in zones of minimum UKC. | 2.54 |
| 32 | Collision Commercial Ship ICW Passenger Vessels | A commercial vessel collides with a passenger vessel due to the presence of the devices | Increased traffic density to the north due to avoidance of the MDZ; 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 | Minimise use of marker buoys in zones of minimum UKC. | 3.45 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|--|---|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 33 | 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; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.27 |
| 34 | Collision Commercial Ship ICW Powered Recreational Vessel | A commercial vessel collides with a powered recreational vessel due to the presence of the devices | Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.72 |
| 35 | Collision Commercial Ship ICW Un-Powered Recreational Vessel | A commercial vessel collides with an un-powered recreational vessel due to the presence of the devices | Insufficient Lookout; Human Error; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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; Moderate 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.72 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|--|---|--|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 36 | 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; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.27 |
| 37 | Collision Passenger Vessels ICW Passenger Vessel | A passenger vessel collides with a passenger vessel due to the presence of the devices | Increased traffic density to the north due to avoidance of the MDZ; 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 | Minimise use of marker buoys in zones of minimum UKC. | 4.00 |
| 38 | 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; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.34 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|---|---|--|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 39 | Collision Passenger Vessels ICW Powered Recreational Vessel | A passenger vessel collides with a powered recreational vessel due to the presence of the devices | Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.82 |
| 40 | Collision Passenger Vessels ICW Un-Powered Recreational Vessel | A passenger vessel collides with an un-powered recreational vessel due to the presence of the devices | Insufficient Lookout; Human Error; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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; Moderate 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.82 |
| 41 | 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; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.34 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|--|---|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 42 | Collision Fishing Vessel ICW Fishing Vessel | A fishing vessel collides with a fishing vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | 2 | 4 | 3 | 1 | 2 | 1.5 | 2.38 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.38 |
| 43 | Collision Fishing Vessel ICW Powered Recreational Vessel | A fishing vessel collides with a powered recreational vessel due to the presence of the devices. | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | 2.5 | 4 | 3 | 1 | 3 | 2 | 3.31 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 3.13 |
| 44 | Collision Fishing Vessel ICW Un-Powered Recreational Vessel | A fishing vessel collides with an un-powered recreational vessel due to the presence of the devices. | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel. | Multiple minor or single major injury; Negligible 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 | 1 | 1 | 1 | 3 | 4 | 2 | 1 | 3 | 3 | 3.67 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.91 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|---|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 45 | Collision Fishing Vessel ICW Other Vessels | A fishing vessel collides with an other vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.47 |
| 46 | Collision Powered Recreational Vessel ICW Powered Recreational Vessel | A powered recreational vessel collides with a powered recreational vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | 3 | 4 | 3 | 1 | 3 | 2 | 3.64 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 3.47 |
| 47 | Collision Powered Recreational Vessel ICW Un-Powered Recreational Vessel | An powered recreational vessel collides with an un-powered recreational vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment and Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel. | Single minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible 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. | 2 | 1 | 1 | 1 | 4 | 4 | 2 | 1 | 3 | 2 | 2.94 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.94 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|---|--|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 48 | Collision Powered Recreational Vessel ICW Other Vessel | A recreational vessel collides with an other vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | 2.5 | 4 | 3 | 1 | 3 | 2.5 | 3.51 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 3.16 |
| 49 | Collision Un-Powered Recreational Vessel ICW Un-Powered Recreational Vessel | An un-powered recreational vessel collides with an un-powered recreational vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel. | Single minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Multiple major injuries or a single fatality; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Temporary suspension of operations or prolonged restrictions to project. | 1 | 1 | 1 | 1 | 5 | 4 | 1 | 1 | 3 | 3 | 2.13 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.00 |
| 50 | Collision Un-Powered Recreational Vessel ICW Other Vessel | An un-recreational vessel collides with an other vessel due to the presence of the devices | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel. | Multiple minor or single major injury; Negligible 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 | 1 | 1 | 1 | 2 | 4 | 2 | 1 | 3 | 2 | 2.94 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.94 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 51 | Collision Other Vessels ICW Other Vessels | An other vessel collides with an other vessel due to the presence of the devices. | Narrowing of the inshore route; Increased utilisation of inshore route; Taking additional risks whilst racing; Insufficient Lookout; Human Error; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; 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 | 2.5 | 4 | 3 | 1 | 2 | 2 | 2.64 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.64 |
| 52 | Grounding / Forced Ashore 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 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |
| 53 | Grounding / Forced Ashore 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 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|--|--|---|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 54 | Grounding / Forced Ashore Fishing Vessel | A fishing vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather. | Grounding with little damage; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Forced ashore onto rocks / cliffs; 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 | 2 | 2.88 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.75 |
| 55 | Grounding / Forced Ashore Powered Recreational Vessel | A recreational vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather. | Grounding with little damage; 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. | Forced ashore onto rocks / cliffs; 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 | 3 | 5 | 3 | 2 | 4 | 3 | 4.67 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 4.18 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|--|--|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|--|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 56 | Grounding / Forced Ashore Un-Powered Recreational Vessel | An un-powered recreational vessel grounds / contacts seabed, rocks or cliff due to the presence of the devices and their moorings. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather. | Grounding with little damage; Single minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations / short term loss of revenue. | Forced ashore onto rocks / cliffs; Multiple fatalities; Minor damage to vessel; Minor effect upon the Environment / Tier 1 - Tier 2 Pollution Criteria Reached; Moderate impact upon operations / temporary suspension / prolonged restrictions. | 2 | 1 | 1 | 1 | 4 | 4 | 2 | 1 | 3 | 3 | 3.37 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.61 |
| 57 | Grounding / Forced Ashore Other Vessel | An other vessel / contacts seabed, rocks or cliff grounds due to the presence of the devices and their moorings. | Narrowing of the inshore route; Increased utilisation of inshore route; Insufficient Lookout; Human Error; Insufficient planning and individual risk assessment prior to departure; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Poor Visibility; Avoidance of other vessel; Running for shelter / safe haven in poor weather. | Grounding with little damage; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Forced ashore onto rocks / cliffs; 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 | 2 | 2.88 | Appropriate alignment and spacing of arrays and devices; Minimise use of marker buoys in zones of minimum UKC. | 2.88 |
| 58 | Swamping / Capsize Commercial Ship | A commercial vessel swamps / capsizes due to the presence of the devices and their moorings. | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|---|---|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 59 | Swamping / Capsize Passenger Vessels | A passenger vessel swamps / capsizes due to the presence of the devices and their moorings. | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |
| 60 | Swamping / Capsize Fishing Vessel | A fishing vessel overwhelmed by sea and swamps / capsizes. | Human Error; Insufficient planning and individual risk assessment prior to departure; Overloading; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Running for shelter / safe haven in poor weather. | Vessel filled with water but does not sink; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue. | Vessel lost, persons in water; Multiple major injuries or a single fatality; Moderate damage to vessel; Minor effect upon the Environment / No pollution; Temporary suspension of operations or prolonged restrictions to project. | 2 | 2 | 1 | 2 | 3 | 4 | 3 | 2 | 3 | 2 | 3.13 | Continuous monitoring by marine coordination centre; Appropriate alignment and spacing of arrays and devices; Provision of life saving equipment on fixed structures and floating devices; Minimise use of marker buoys in zones of minimum UKC. | 3.13 |
| 61 | Swamping / Capsize Powered Recreational Vessel | A powered recreational vessel overwhelmed by sea and swamps / capsizes. | Human Error; Insufficient planning and individual risk assessment prior to departure; Taking additional risks during racing; Equipment or Mechanical Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Running for shelter / safe haven in poor weather. | Vessel filled with water but does not sink; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue. | Vessel lost, persons in water; Multiple fatalities; Moderate damage to vessel; Minor effect upon the Environment / No pollution; Temporary closure or prolonged restrictions. | 2 | 2 | 1 | 2 | 3 | 5 | 3 | 2 | 4 | 2 | 3.55 | Continuous monitoring by marine coordination centre; Appropriate alignment and spacing of arrays and devices; Provision of life saving equipment on fixed structures and floating devices; Minimise use of marker buoys in zones of minimum UKC. | 3.55 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|---|---|---|--|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 62 | Swamping / Capsize Un-Powered Recreational Vessel | An un-powered recreational vessel overwhelmed by sea and swamps / capsizes due to the presence of the devices and their moorings. | Human Error; Insufficient planning and individual risk assessment prior to departure; Taking additional risks during racing; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Running for shelter / safe haven in poor weather. | Vessel filled with water but does not sink; Single minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations / short term loss of revenue. | Vessel lost, persons in water; 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. | 2 | 1 | 1 | 1 | 5 | 4 | 2 | 1 | 3 | 3 | 4.13 | Continuous monitoring by marine coordination centre; Provision of life saving equipment on fixed structures and floating devices. | 4.13 |
| 63 | Swamping / Capsize Other Vessel | An other vessel overwhelmed by sea and swamps / capsizes due to the presence of the devices and their moorings. | Human Error; Insufficient planning and individual risk assessment prior to departure; Overloading; Equipment Failure; Adverse Environmental Conditions; Effect of establishment of devices on tidal streams, eddies, overfalls and waves; Running for shelter / safe haven in poor weather. | Vessel filled with water but does not sink; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Minor impact upon operations/ short term loss of revenue. | Vessel lost, persons in water; Multiple major injuries or a single fatality; Moderate damage to vessel; Minor effect upon the Environment / No pollution; Temporary suspension of operations or prolonged restrictions to project. | 2 | 2 | 1 | 2 | 3 | 4 | 3 | 2 | 3 | 2 | 3.13 | Continuous monitoring by marine coordination centre; Appropriate alignment and spacing of arrays and devices; Provision of life saving equipment on fixed structures and floating devices; Minimise use of marker buoys in zones of minimum UKC. | 3.13 |
| 64 | Snagging/ Obstruction Commercial Ship | A commercial vessel's anchor interacts with a cable, the device, its moorings or marker buoy moorings. | Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Insufficient cable protection; Adverse Environmental Conditions; Running for shelter / safe haven in poor weather. Poor Visibility; Navigation aid failure. | Anchor snags mooring lines or power cables but cleared on weighing; 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. | Anchor snags mooring lines or power cables but cannot be cleared on weighing anchor seriously damaging moorings, devices or power cables; 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; Restrict navigation through gold and green MDZ zones; Appropriate alignment and spacing of arrays and devices; Check Device Surveys; Establish no anchoring areas; Enhanced cable protection; Minimise use of marker buoys in zones of minimum UKC. | 1.74 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|---|--|--|--|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 65 | Snagging/Obstruction Passenger Vessels | A ferry's anchor interacts with a cable, the device, marker buoy or its moorings. | Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure. | Anchor snags mooring lines or power cables but cleared on weighing; 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. | Anchor snags mooring lines or power cables but cannot be cleared on weighing seriously damaging moorings, devices or power cables; 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; Restrict navigation through gold and green MDZ zones; Appropriate alignment and spacing of arrays and devices; Check Device Surveys; Establish no anchoring areas; Enhanced cable protection; Minimise use of marker buoys in zones of minimum UKC. | 1.85 |
| 66 | Snagging/Obstruction Fishing Vessel | A fishing vessel's gear/ anchor interacts with a cable, the device, marker buoy or its moorings. | Fishing gear snags moorings, device or power cable; Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure. | Fishing gear or anchor snags mooring lines or power cables but cleared; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Fishing gear or anchor snags mooring lines or power cables but cannot be cleared seriously damaging moorings, devices or power cables; 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 | 3 | 4.50 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through gold and green MDZ zones; MDZ designation as no fishing zone; Appropriate alignment and spacing of arrays and devices; Check Device Surveys; Establish no anchoring areas; Enhanced cable protection; Minimise use of marker buoys in zones of minimum UKC. | 2.76 |
| 67 | Snagging/Obstruction Powered Recreational Vessel | A powered recreational vessel's gear/ anchor interacts with a cable, the device, marker buoy or its moorings. | Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure. | Anchor snags mooring lines or power cables but cleared; No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Anchor snags mooring lines or power cables but cannot be cleared seriously damaging moorings, devices or power cables; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through gold and green MDZ zones; Appropriate alignment and spacing of arrays and devices; Check Device Surveys; Establish no anchoring areas; Enhanced cable protection; Minimise use of marker buoys in zones of minimum UKC. | 0.56 |

| ID | Hazard Title | Hazard Detail | Possible Causes | Most Likely Outcome | Worst Credible Outcome | Most Likely Consequence | | | | | Worst Credible Consequence | | | | | Baseline Risk Score | Suggested Additional Mitigation Measures | Residual Risk Score |
|----|--|---|--|--|---|-------------------------|----------|-------------|----------|-----------|----------------------------|----------|-------------|----------|-----------|---------------------|---|---------------------|
| | | | | | | People | Property | Environment | Business | Frequency | People | Property | Environment | Business | Frequency | | | |
| 68 | Snagging/ Obstruction Un-Powered Recreational Vessel | An un-powered recreational vessel's gear/ anchor interacts with a cable, the device, marker buoy or its moorings. | N/A | N/A | N/A | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0.00 | NOT SCORED | 0.00 |
| 69 | Snagging/ Obstruction Other Vessel | An other vessel's gear/anchor interacts with a cable, the device, marker buoy or its moorings. | Emergency anchoring; Anchoring in an inappropriate position; Equipment or Mechanical Failure; Adverse Environmental Conditions; Poor Visibility; Navigation aid failure. | Anchor snags mooring lines or power cables but cleared; No Injury / Possible very minor injury; Negligible damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Anchor snags mooring lines or power cables but cannot be cleared seriously damaging moorings, devices or power cables; 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 | Continuous Monitoring by Marine Co-ordination Centre; Restrict navigation through gold and green MDZ zones; Appropriate alignment and spacing of arrays and devices; Check Device Surveys; Establish no anchoring areas; Enhanced cable protection; Minimise use of marker buoys in zones of minimum UKC. | 2.38 |
| 70 | Breakout of device / device not at stated depth | The device's moorings fail, device becomes a hazard to navigation. | Equipment / mooring failure; Adverse Environmental Conditions; Contact by vessel. | Mooring failure, device remains in position and at stated depth; Minor injury; Minor damage to vessel; Negligible effect upon the Environment / No pollution; Negligible impact upon operations. | Mooring failure, device breaks free or no longer at stated depth / required UKC and becomes contact hazard; 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 gold and green MDZ zones; Continuous Monitoring by Marine Co-ordination Centre; Check device surveys; Establish no anchoring areas. | 2.40 |

Annex D NRA Addendum Stakeholder Consultation Minutes (2020)

Minutes of Meeting held on 06-August-20 – Chamber of Shipping

Client: Menter Môn (MM)

Project: Morlais Tidal Demonstration Zone – NRA Addendum

Venue: Teams Teleconference

Date of Meeting: 06th August 2020 at 14:00

Chamber of Shipping (COS) Robert Merrylees (RM)

Marico Marine (MR) David Foster (DF)

Rebecca Worbey (RW)

| Item | Action item / Notes for the record | Action |
|------|--|--------|
| 1 | Introduction | |
| | <ul style="list-style-type: none">RW introduced the project:<ul style="list-style-type: none">NRA Addendum to assess changes to the layout that have been incorporated since the original NRA Assessment.RW outlined the agenda for the meeting. | |
| 2 | NRA Addendum Assessment Layout | |
| | <ul style="list-style-type: none">RW explained that the main changes since the previous NRA assessed layout are that the MDZ has been divided into zones of minimum Under Keel Clearance (UKC) and particularly that the NRA recommended mitigation measures relating to UKC at the northern and eastern boundary have been embedded into the project design.<ul style="list-style-type: none">RM commented that the new layout appeared to be a positive step forward. | |
| 3 | Vessel Traffic Analysis | |
| | <p>Vessel traffic plots overlaid with the new layout were reviewed.</p> <ul style="list-style-type: none">Ferries<ul style="list-style-type: none">RM commented that the 20m UKC zone does still see a fair amount of traffic and ferries are still noted crossing the 'gold zone', however, the introduction of the zone of 20m UKC should now allow vessels to safely pass to the north of the 'gold' zone.RM considers the introduction of the 20m UKC zone to be an adequate compromise and safety provision.Cruise Ships<ul style="list-style-type: none">Deep draft vessels required to maintain an adequate distance from the coastline. Routes are discretionary. Diverting around the MDZ should not be an issue for them.Coasters | |

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| | <ul style="list-style-type: none"> ○ Very few seen to operate through the site. ○ Their diversion to the west of the site would be relatively minor. ○ DF commented that due to its proximity, many commercial vessels utilise the TSS. ● Recreational <ul style="list-style-type: none"> ● RM mentioned that it was not in his remit as a representative of the COS to comment on recreational vessel traffic, however, noted that the extension of the inshore route via the introduction of an 8m minimum UKC seemed pragmatic. ● Fishing <ul style="list-style-type: none"> ● The COS is not in a position to comment. <p>The minutes from the previous NRA consultation were reviewed and key relevant points discussed with reference to the new layout:</p> | |
| 4 | Poor Weather Routeing | |
| | <ul style="list-style-type: none"> ● RM mentioned that he has sought feedback from Irish Ferries and Stena Line on the proposed new layout but as of yet has not received any specific feedback. <ul style="list-style-type: none"> ● RW commented that Irish Ferries and Stena Line have been contacted to participate in the NRA Addendum consultation process. ● From the COS's perspective the changes introduced represent a pretty good compromise in terms of navigation safety. ● DF questioned what the main drivers are for utilisation of a poor weather route. <ul style="list-style-type: none"> ● RM explained that while lashing is a factor, passenger safety and comfort is the primary concern. Taking an alternative course during poor weather can reduce passenger discomfort for crossings of longer duration. | |
| 5 | Marking and Lighting | |
| | <ul style="list-style-type: none"> ● RM questioned how the site is to be marked. <ul style="list-style-type: none"> ○ DF commented that marking and lighting at this stage is not defined. It is expected that the marking will be similar in principle to how a wind farm is marked (for example, 5-mile lights on the western edge). ○ RM noted that the boundary between the purple and gold zones will need to be clearly marked, particularly if sub-surface devices are installed in the gold zone that are not surface piercing and which do not allow 20m UKC for ferry navigation. ○ RM noted that marking of the and NE and NW corners will be the most important. | |
| 6 | Area to be Avoided (ATBA) | |
| | <p>DF questioned COS's view on designation of the site as an ATBA.</p> <ul style="list-style-type: none"> ● RM commented that it is understood that Safety Zones will be applied for during construction and maintenance however, these are not considered to be a long-term solution. RM commented that MM had indicated that 50m Safety Zones were being considered for the operational phase which he didn't | |

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| | <p>consider normal practice for renewable devices and requested further information.</p> <ul style="list-style-type: none"> • RM considered that while an ATBA may be appropriate to some vessels it may not be to all. A prudent mariner would look at charts, marks and notes and make their own judgement, therefore, freedom of navigation supported by adequate information and marking would be preferred. • There is a concern that if the site is to be designated an ATBA that it may set a precedent for future developments to be marked as such. • Ultimately this will be a regulator decision. | |
| 7 | Hazard Review | |
| | <ul style="list-style-type: none"> • Collision <ul style="list-style-type: none"> ○ Western route around MDZ – RM doesn't see any increase in collision risk. ○ Eastern inshore route – Likely an increase to collision risk for small vessels utilising the inshore route when compared to the existing baseline. However, the risk of collision would likely be reduced in comparison to the previously assessed NRA design following implementation of mitigation. • Contact <ul style="list-style-type: none"> ○ The presence of structures in the water will increase contact risk (including with buoys and other supporting infrastructure). ○ Suitable usage of lights and marks should mitigate against contact risk. • Search and Rescue (SAR) <ul style="list-style-type: none"> ○ This will primarily concern smaller vessels and is not such an issue for large commercial vessels. ○ RM questioned if the device arrangement is known, if devices will be grouped in arrays and if there will be chartable routes through the site. <ul style="list-style-type: none"> ▪ RW confirmed that the devices will be arranged in arrays however, the layout is at this stage is not confirmed. ▪ RM observed that a more 'organic' design may be required to maximise production, however, lines and squares are typically preferable for SAR. | |
| 8 | Other comments | |
| | <p><u>Programme</u></p> <ul style="list-style-type: none"> • RM requested clarity on the consenting programme and how the NRA Addendum will feed into the process and if it will be available in the public domain for comment. • RW to seek clarification on consenting programme and revert. | RW |

Minutes of Meeting held on 07-August-20 – Trinity House

Client: Menter Môn (MM)

Project: Morlais Tidal Demonstration Zone – NRA Addendum

Venue: Teams Teleconference

Date of Meeting: 07th August 2020 at 09:00

Trinity House (TH) Trevor Harris (TR)
Stephen Vanstone (SV)

Marico Marine (MR) David Foster (DF)
Rebecca Worbey (RW)

| Item | Action item / Notes for the record | Action |
|------|--|--------|
| 1 | Introduction | |
| | <ul style="list-style-type: none">RW introduced the project:<ul style="list-style-type: none">NRA Addendum to assess changes to the layout that have been incorporated since the original NRA Assessment.RW outlined the agenda for the meeting. | |
| 2 | NRA Addendum Assessment Layout | |
| | <ul style="list-style-type: none">RW explained that the main changes since the previous NRA assessed layout are that the MDZ has been divided into zones of minimum Under Keel Clearance (UKC) and particularly that the NRA recommended mitigation measures relating to UKC at the northern and eastern boundary have been embedded into the project design.<ul style="list-style-type: none">TH commented that while they had not seen this layout they were aware of the Interactive Boundary Assessments undertaken by Marico Marine and the proposed changes to the eastern boundary.TH commented that the layout does not look to dissimilar to that assessed previously.Vessel traffic plots overlaid with the new layout were reviewed.The minutes from the previous NRA consultation were reviewed and key relevant points discussed with reference to the new layout: | |
| 3 | Device Layout | |
| | <ul style="list-style-type: none">TH questioned whether there was a more detailed layout design available at this stage or any indication of how the devices are to be arranged. TH noted that previously the site was subdivided into subzones with each zone to be utilised by different devices and developers. | |

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| | <ul style="list-style-type: none"> ○ RW explained there is not a detailed device specific layout at this time as the project continues to utilise a Project Design Envelope Approach. ○ Marine infrastructure will be arranged into arrays with each array containing a single device type. The proposed spatial layout of each array is unknown at this stage but will adhere to the minimum UKC restrictions indicated within the layout (Item 2). • TH pointed out that it would expect surface and surface breaking devices to be aligned in straight rows ensuring clear lines of sight and to maximise marking and visibility. TH pointed out that they would not want instances of isolated surface breaking devices requiring marking separated from the primary arrays. • TH will look to have the determination of layouts agreed post consent and secured in the TWAO, accordingly. • TH suggests sign off on layouts should be carried out by NRW in consultation with TH and the MCA. | |
| 4 | Marking and Lighting | |
| | <ul style="list-style-type: none"> • DF requested TH to indicate how in principle the site would be marked. <ul style="list-style-type: none"> ○ TH explained that it will be similar in principle to how a wind farm is marked (for example, 5 mile lights on the western edge), however, TH would not be able to comment on marking at this stage. ○ Marking will need to be determined once a device specific layout is agreed and once there is an indication of what will be developed and in what order. ○ As previously stated, any individual structures remote from the development would need to be further risk assessed and considered separately. • TH commented that conversations have been undertaken separately with MM in regards to marking of individual devices in terms of visual impact and the requirement for surface piercing devices to be painted yellow. • RW questioned in the cases of areas where devices are not surface piercing there would be a requirement for a surface mark. <ul style="list-style-type: none"> ○ TH noted that this is the case at Minesto which has a buoy marking a device of 20m UKC. ○ It may be the case that marking broad areas is more appropriate than the marking of individual devices however, TH reiterated that they would need more information on the device types and layout to determine if / where marking would be required. | |
| 5 | Area to be Avoided (ABTA) | |
| | <p>DF questioned TH's view on designation of the site as an ATBA.</p> <ul style="list-style-type: none"> • TH stated that the preference would be for the site to remain as open for use as possible. Charting by the UKHO and marking by TH should allow mariners to make an informed decision about entry. Generally, where devices are charted by UKHO, mariners tend to avoid the area anyway (generally observed at windfarms). | |
| 6 | Other comments | |

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| | <ul style="list-style-type: none">• TH explained that it often has a vessel with a heli-pad working off South Stack lighthouse, however, SV and TR noted that this is an operational rather than navigation risk issue and discussions in regard to this matter have been ongoing between their colleagues and MM. <p><u>Programme</u></p> <ul style="list-style-type: none">• TH questioned what the licence application programme looks like.<ul style="list-style-type: none">○ RW to seek clarification from MM and revert. | RW |
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Minutes of Meeting held on 10-August-20 – Maritime and Coastguard Agency

Client: Menter Môn (MM)

Project: Morlais Tidal Demonstration Zone – NRA Addendum

Venue: Teams Teleconference

Date of Meeting: 10th August 2020 at 14:00

Maritime and Coastguard Nick Salter(NS)

Agency (MCA)

Marico Marine (MR)

David Foster (DF)

Rebecca Worbey (RW)

| Item | Action item / Notes for the record | Action |
|------|--|--------|
| 1 | Introduction | |
| | <ul style="list-style-type: none">RW introduced the project:<ul style="list-style-type: none">NRA Addendum to assess changes to the layout that have been incorporated since the original NRA Assessment.RW outlined the agenda for the meeting. | |
| 2 | NRA Addendum Assessment Layout | |
| | <ul style="list-style-type: none">RW explained that the main changes since the previous NRA assessed layout are that the MDZ has been divided into zones of minimum Under Keel Clearance (UKC) and particularly that the NRA recommended mitigation measures relating to UKC at the northern and eastern boundary have been embedded into the project design.<ul style="list-style-type: none">NS commented that the MCA is aware of the area of 8m UKC to the east and 20m UKC to the north following review of the IB Assessments, however, had not had sight of the extended area of 20m UKC to the SW and S.The updated minimum 8m UKC zone design, now following a straighter line, is considered to be an improvement on the previously proposed design.Vessel traffic plots overlaid with the new layout were reviewed.<ul style="list-style-type: none">NS no further comments on the layout so far. <p>The minutes from the February 2020 consultation meeting held between Menter Môn, Marine Space and the MCA were reviewed, and key relevant points discussed with reference to the new layout:</p> | |

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| 3 | Data Analysis | |
| | <ul style="list-style-type: none"> RW requested confirmation that the AIS and RADAR data utilised within the original NRA is considered fit for purpose for utilisation within the NRA Addendum. <ul style="list-style-type: none"> NS confirmed that the original NRA data is valid for use within the NRA Addendum as; the original NRA submission was made within 2 years of the data collection and as extensive further supporting assessments have been undertaken by the project; Interactive Boundary Assessments, for example. | |
| 4 | Mitigation Measures | |
| | <p><u>Exclusion of Fishing</u></p> <ul style="list-style-type: none"> DF requested clarification on the MCA's thoughts around the mitigation measure 'Exclusion of Fishing'. <ul style="list-style-type: none"> The MCA feel that fishing will be excluded by default and therefore it does not see a need to formalise the exclusion of fishing. This has not been requested at other similar OREI sites. As long as up-to-date information is correctly promulgated to stakeholders and the MDZ is marked on navigational charts, fishermen should be aware of the MDZ. NS pointed out that should the project wish to proceed with an application to exclude fishing within the MDZ then the application will be handled by DEFRA. DF noted that this measure mitigates against snagging and contact and that the effectiveness of the measure could be assessed within the NRA Addendum. <p><u>Area To Be Avoided (ATBA)</u></p> <ul style="list-style-type: none"> Applications for an ATBA would need to be made to the MCA and IMO. Proper charting and marking allowing a prudent mariner to make their own judgement would allow freedom of navigation. <ul style="list-style-type: none"> In this case, proper notifications should be given when installations are taking place. Local notifications including local Notices to Mariners and other appropriate Maritime Safety Information should be issued. International notifications may include; Notice to Mariners, T&Ps, NavArea1, Hydrolants etc. <p><u>Guard Vessels</u></p> <ul style="list-style-type: none"> Clarification was sought on the use of guard vessels noting the following statement recorded in the February 2020 minutes '<i>a Guard Vessel for the Operations as well as Construction phase of the project.</i>' <ul style="list-style-type: none"> NS clarified that this mitigation measure is recommended for use in the construction phase only. | |

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| 5 | Recreational Vessels | |
| | <ul style="list-style-type: none">• RW explained that following stakeholder feedback, the NRA Addendum will separate the assessment of recreational vessels into powered and un-powered recreational vessels to provide further clarity to un-powered recreational stakeholders.<ul style="list-style-type: none">○ NS agreed this seemed like a positive approach.• It was additionally discussed that further clarity around safe havens and running for shelter will be provided within in the NRA Addendum. | |
| 6 | Other comments | |
| | <ul style="list-style-type: none">• NS referred MR to his NRW Marine Licence Application response; specifically, the terminology utilised within the original NRA to describe mitigation measures. NS requested that consistent terminology be utilised throughout the NRA Addendum.• NS questioned if further engagement had been undertaken with the ferry operators.<ul style="list-style-type: none">○ RW explained that the ferry masters had been approached to provide stakeholder input to the NRA Addendum.• The MCA confirmed that it was content with the Interactive Boundary Assessments presented by MR. | |

Minutes of Meeting held on 20-11-2018 - Amended following comments received on 31 July 2020.

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. Further comments received on 31 July 2020.

| | |
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| 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 (project currently on hold /delayed); | |

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| | 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 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 [traffic survey data from: winter 2017 and summer 2017] 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 | Anchoring | |
| | <ul style="list-style-type: none"> KR was unaware of commercial vessels anchoring in Abrahams Bosom. | |
| 6 | 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. | |

Email Consultation Minutes – Trearddur Bay Sailing Club

Client: Menter Môn
Project: Morlais Tidal Demonstration Zone
Consultee: Trearddur Bay Sailing Club

| | |
|----------------------------|----------------|
| Trearddur Bay Sailing Club | Matthew Davis |
| Marico Marine | Rebecca Worbey |
| Marico Marine | David Foster |

From: Matthew Davis

To: Rebecca Worbey,

Cc: Richard Hill, David Foster

Sent: 06 August 2020, 17:37

Subject: RE: Morlais Tidal Demonstration Zone - Navigation Risk Assessment

Dear Rebecca,

Many thanks for sending the letter through and for recognising Trearddur Bay Sailing Club and our 1,100 members as key stakeholders.

Having reviewed the plan, we can see little material improvement over the previous scheme and still have grave concerns over the impact on yachting, the visual impact from Trearddur Bay and the impact on the seabirds at South Stack.

Our role is to focus on the risk to yachting and recreational use of the sea around South Stack and Holy Island.

1. We still feel that any surface mounted or surface piercing devices present an unacceptable risk to shipping and yachting at this point on the coast. We outlined in detail our concerns in the consultation meeting of November 2018 (at Holyhead) and see no improvement in the scheme as presented.
2. We still feel that the navigable corridor between the proposed area and South Stack is far too narrow and presents a very dangerous 'lee-shore' risk, with the prevailing south westerlies to the treacherous shoreline of South Stack, Abrahams Bosom and it should be remembered that there is a complex series of back-eddies (the 'seven tides') that make sailing by Abrahams Bosom very tricky. We really fear a risk to life if this whole stretch becomes only a narrow navigable corridor.
3. We support the RYA position that it is unacceptable to define the scheme as a test area, where no pre-approval of technology is necessary and whereby any impact assessments are

rendered theoretical by the lack of commitment to turbine type - for us this is simply too open ended.

In broad terms we would support the whole scheme, were the Developer to commit to a purely under water array, but as it stands the revisions serve to offer no meaningful improvement over the previous scheme. We support green energy schemes that help the local economy, but this one is laden with risk and poor thinking. The recreational boating market on Anglesey and the Holy Island is of huge value to the economy and should not be forgotten.

We urge the Developer to think again and would fully support the RYA position on this scheme.

Yours

Matthew Davis

Rear Commodore, Trearddur Bay SC

Email Consultation Minutes – Snowdonia Canoe Club

Client: Menter Môn
Project: Morlais Tidal Demonstration Zone
Consultee: Snowdonia Canoe Club

| | |
|----------------------|----------------|
| Snowdonia Canoe Club | Jenny Wong |
| Marico Marine | Rebecca Worbey |
| Marico Marine | David Foster |

From: Jenny Wong

To: Rebecca Worbey,

Cc: David Foster, Phil Stone

Sent: 16 August 2020, 16:53

Subject: RE: Morlais Tidal Demonstration Zone - Navigation Risk Assessment

Snowdonia Canoe Club

16 August 2020

Dear Rebecca,

Many thanks for your invitation to participate in the NRA Addendum consultation process in the in accordance with the provisions of MGN 543.

As requested, I circulated the questions and your Figure 1 (20UK1647_Morlais_NRA_Layout) among SCC members and also with other sea kayak stakeholders. This response is drawn from this consultation and previous submissions by the sea kayak community to consultations on the NRA. The zonation of the MDZ as indicated in your Figure 1 should not itself impede passage around the Stacks by kayak. However, as outlined in our previous responses to the TWAO and Marine license consultations we are concerned that (a) changes to the hydrodynamics of the inshore passage may render it unsafe for existing use, (b) floating and emergent structures within the MDZ are a significant hazard and pose a risk to life and (c) exclusion zones during construction may restrict passage.

The risks to kayak navigation largely arise from changes to flow and wave regimes. To assess the

cumulative impact of these changes we need to be able to inspect the outputs of the hydrodynamic modelling. As you pointed out Morlais provided us with copies of the revised Wallingford report but the figures are too small to see the detail of interest to us. I have requested higher resolution images from Morlais but these have not yet been provided. Since this is the case our concerns are unchanged from those previously submitted and we can only reassert that the navigation risk for kayaks between the coast and MDZ are likely to be intolerable. For further detail I suggest you examine the SCC and Canoe Wales responses to the TWAO and NRW consultations, the personal consultation responses from sea kayakers and the minutes of our meeting with Morlais on the 10 February 2020.

1. Changes to your current activities within vicinity of the project;

Sea kayaks are generally just over 5 m long, up to 0.5 m wide with a draught of less than 0.15 m. As self-powered paddle craft we have limited forward speed – generally navigation planning would work on a 6 km/hr (1.6 m/sec) forward speed. A strong paddler may have a maximum speed of twice this but it can only be sustained for short periods of time. We work at an intimate scale with the water; using eddies for safety and to make progress against the prevailing tide while standing waves on overfalls are used as ‘play’ features to surf against the flow as well as for passage.

The changes indicated in the Wallingford model suggest increases in flow speed of up to 0.8 m/sec and up to 0.5 m to wave heights. This alone would prevent passage by a significant proportion of paddlers. In addition hydrodynamic changes may also compromise safety features such as eddies and access to land such that use as a training and guiding location maybe compromised. Without further detail we would have to conclude that Morlais represents a significant risk and will curtail current activities.

2. Areas where you consider navigational risks to have changed;

Navigational risk will be significantly increased in the whole of the area within and landward of the MDZ and perhaps further afield e.g. Carmel Head and the Skerries.

Within the MDZ we consider there will be a significant risk to life from interactions with emergent and floating infrastructure. Once we stop paddling, say for example, to put someone back in their boat after a capsize (a not uncommon occurrence as the area is used for rescue training and practice) we are at the mercy of the tide and will be rapidly swept into the MDZ where we would be very vulnerable to collision and/or entanglement as in a rescue situation we are unable to manoeuvre, will be trailing tow ropes and may have swimmers in

the water.

3. Any additional risk control measures you consider could be introduced to allow operations and navigation to continue safely;

As we pointed out at the meeting with Morlais, proposed mitigation in the form of grab chains and ladders will actually render the structures more and not less hazardous because of entanglement, the inability of a swimmer to hold on against the tide and likely extreme difficulty of undertaking a rescue close to the floating structure.

Ideally risk control measures would take the form of a safe runout of, say, ten minutes at peak flow 'downstream' of features such as Penrhyn Mawr on the flood and North Stack on the ebb.

4. Any other observations or general points relevant to shipping and navigation.

We are concerned about the risks posed to kayaks of sharing the inshore passage with construction and other recreational vessels as at present we encounter few other vessels – at most a handful of low speed small commercial and recreational fishing boats and occasional dive boats.

Yours sincerely,



Jenny Wong
Pp Snowdonia Canoe Club
Cc Canoe Wales

Email Consultation Minutes – Snowdonia Canoe Club

Client: Menter Môn
Project: Morlais Tidal Demonstration Zone
Consultee: Canoe Wales

| | |
|---------------|----------------|
| Canoe Wales | Phil Stone |
| Marico Marine | Rebecca Worbey |
| Marico Marine | David Foster |

From: Phil Stone

To: Rebecca Worbey,

Sent: 17 August 2020, 15:52

Subject: Marico Marine Response

National White Water Centre
Canolfan Tryweryn, Frongoch,
Bala, Gwynedd. LL23 7NU

01678 521199
admin@canoewales.com
www.canoewales.com

Canŵ Cymru

CanoeWales

Marine and Risk Consultants Ltd

Marico House,

Bramshaw,

Southampton

SO43 7JB,

United Kingdom 17/08/2020

Re: Navigation Risk Assessment Addendum for the proposed Morlais Tidal Demonstration zone (MDZ).

Dear Rebecca,

Thank you for the opportunity to respond to this consultation. Unfortunately, the timescales attached to the consultation prevented us from sharing this widely to broker a response from our members.

Canoe Wales is the Governing Body for Paddlesport in Wales.

We are here to support our members, advocate for canoeing and kayaking in Wales and help paddlers at every step on their paddlesport career – whether they are recreational paddlers who want to enjoy our gorgeous lakes, rivers and coastal waters, or competitive paddlers on their way to Olympic or Paralympic podiums.

Following discussions with Snowdonia Canoe club, Canoe Wales has nothing further to add to their submission. We fully endorse their response as replicated below.

Sea kayaking is a significant activity around Anglesey with the waters around the tidal array being particularly popular. Many clubs both locally and from across the UK come to paddle in the area, and there is also a thriving guiding community taking groups out. It is highly likely that this development would have a significant impact on anyone wishing to kayak in that area.

1. Changes to your current activities within vicinity of the project; Sea kayaks are generally just over 5 m long, up to 0.5 m wide with a draught of less than 0.15 m. As self-powered paddle craft we have limited forward speed – generally navigation planning would work on a 6 km/hr (1.6 m/sec) forward speed. A strong paddler may have a maximum speed of twice this, but it can only be sustained for short periods of time. We work at an intimate scale with the water; using eddies for safety and to make progress against the prevailing tide while standing waves on overfalls are used as ‘play’ features to surf against the flow as well as for passage. The changes indicated in the Wallingford model suggest increases in flow speed of up to 0.8 m/sec and up to 0.5 m to wave heights. This alone would prevent passage by a significant proportion of paddlers. In addition, hydrodynamic changes may also compromise safety features such as eddies and access to land such that use as a training and guiding location maybe compromised. Without further detail we would have to conclude that Morlais represents a significant risk and will curtail current activities.

2. Areas where you consider navigational risks to have changed; Navigational risk will be significantly increased in the whole of the area within and landward of the MDZ and perhaps further afield e.g. Carmel Head and the Skerries. Within the MDZ we consider there will be a significant risk to life from interactions with emergent and floating infrastructure. Once we stop paddling, say for example, to put someone back in their boat after a capsized (a not uncommon occurrence as the area is used for rescue training and practice) we are at the mercy of the tide and will be rapidly swept into the MDZ where we would be very vulnerable to collision and/or entanglement as in a rescue

situation we are unable to manoeuvre, will be trailing tow ropes and may have swimmers in the water.

3. Any additional risk control measures you consider could be introduced to allow operations and navigation to continue safely; As we pointed out at the meeting with Morlais, proposed mitigation in the form of grab chains and ladders will actually render the structures more and not less hazardous because of entanglement, the inability of a swimmer to hold on against the tide and likely extreme difficulty of undertaking a rescue close to the floating structure. Ideally risk control measures would take the form of a safe runout of, say, ten minutes at peak flow 'downstream' of features such as Penrhyn Mawr on the flood and North Stack on the ebb.

4. Any other observations or general points relevant to shipping and navigation. We are concerned about the risks posed to kayaks of sharing the inshore passage with construction and other recreational vessels as at present we encounter few other vessels – at most a handful of low speed small commercial and recreational fishing boats and occasional dive boats.

Kind regards

Phil Stone

A handwritten signature in black ink, appearing to read 'Phil Stone', with a long horizontal stroke extending to the right.

Places to Paddle Manager

Email Consultation Minutes – Irish Ferries

Client: Menter Môn
Project: Morlais Tidal Demonstration Zone
Consultee: Irish Ferries

| | |
|---------------|--|
| Irish Ferries | Brian McKenna via Robert Merrylees - Chamber of Shipping |
| Marico Marine | Rebecca Worbey |
| Marico Marine | David Foster |

From: Robert Merrylees

To: Rebecca Worbey,

Cc: David Foster

Sent: 14 August 2020, 16:04

Subject: FW: Project Morlais – Tidal Anglesey

Robert,

Irish Ferries comments as follows:

1. The 20m UKC is of great benefit and assuages most of our concerns
2. The proposed development will prevent the use of certain routes that are only used rarely in particular circumstances, and we can accept this
3. The proposed development will still restrict options for ferries that cannot enter the Port of Holyhead in inclement weather – i.e. it limits areas in which to shelter
4. The proposed development leads to less sea room for traffic going in and out of Holyhead to safely pass each other. Inbound/Eastbound traffic may tend to navigate further north than it does presently, with the result that outbound/westbound traffic will be pushed further north, with the risk of impinging on the Traffic Separation Scheme
5. Northbound Traffic bound for the TSS may be less inclined to alter to starboard (towards the development) to give way to outbound/westbound traffic from Holyhead

Kind regards,

Brian

Email Consultation Minutes – Stena Line

Client: Menter Môn
Project: Morlais Tidal Demonstration Zone
Consultee: Stena Line

| | |
|---------------|--------------------|
| Stena Line | William Calderbank |
| Marico Marine | Rebecca Worbey |
| Marico Marine | David Foster |

From: William Calderbank

To: Rebecca Worbey,

Cc: David Foster, Kevin Riley , Robert Merrylikes

Sent: 01 September 2020, 09:14

Subject: RE: Morlais Tidal Demonstration Zone - Navigation Risk Assessment

Good Morning Rebecca,

I have consulted with our Masters and with Irish Ferries. Our response is in line with that from Irish Ferries.

1. The 20m UKC is of great benefit and allays most of our concerns
2. The proposed development will prevent the use of certain routes that are only used rarely in particular circumstances, and we can accept this
3. The proposed development will still restrict options for ferries that cannot enter the Port of Holyhead in inclement weather – i.e. it limits areas in which to shelter
4. The proposed development leads to less sea room for traffic going in and out of Holyhead to safely pass each other. Inbound/Eastbound traffic may tend to navigate further north than it does presently, with the result that outbound/westbound traffic will be pushed further north, with the risk of impinging on the Traffic Separation Scheme
5. Northbound Traffic bound for the TSS may be less inclined to alter to starboard (towards the development) to give way to outbound/westbound traffic from Holyhead

Best Regards,

Will

Email Consultation Minutes – Royal Yachting Association (RYA)

Client: Menter Môn
Project: Morlais Tidal Demonstration Zone
Consultee: Royal Yachting Association

| | |
|----------------------------|----------------|
| Royal Yachting Association | Richard Hill |
| Marico Marine | Rebecca Worbey |
| Marico Marine | David Foster |

From: Richard Hill

To: Rebecca Worbey,

Cc: David Foster, Phil Horton

Sent: 03 September 2020, 16:18

Subject: RE: Morlais Tidal Demonstration Zone – Marico Marine NRA Addendum Stakeholder Consultation

Dear Rebecca,

Thank you for your email. There appears to be some confusion. I have been informed by a colleague that Morlais/ Menter Mon has now purchased a license for the RYA Coastal Atlas. Given the consultation responses to you from our members, our previous meetings with Morlais/ Menter Mon in 2018 and 2020, our objections to the project – together with the recently supplied RYA Coastal Atlas: the RYA has now provided all relevant information. Please note that the changes made to the Eastern boundary do not substantially alter our view on navigational risk, as these changes do not meet the safety requirements identified in our previous meetings with the Morlais project.

We would appreciate some clarification as to what this information will be used for (please see my letter to James Orme) and we will be interested to see how the MDZ proposals will be reconciled with the existing Boating Area.

Best Regards

Richard

Annex E Original (2019) NRA Stakeholder Consultation Minutes

Minutes of Meeting held on 19-11-2018

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 Trevor Jones (TJ)
(WA)
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 MDZ | |
| | <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. | |

| | | |
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| | <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 MDZ 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. • TJ – 8m minimum UKC required for fishing vessels to navigate over devices. • The separation between / spread of devices will be of highest concern. | |

| | | |
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| | <ul style="list-style-type: none"> 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

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 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. 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. | |
| 2 | Holyhead Operations and Port Development KR and WP outlined the current port operations including: <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; andRecreation (including the damage to the Holyhead Marina in Q1/18). Port Development Plan: <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;The Port Development Plan is planned to be submitted in Q1/19. | |

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| | <ul style="list-style-type: none"> 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

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 Routing</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 routing.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. <p><u>Fishing Vessels</u></p> | |

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| | <ul style="list-style-type: none"> • Whelk fisherman are active to the west, close to Minesto. • Fisherman not often witnessed within the proposed MDZ 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

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. 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. | |

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| | <ul style="list-style-type: none"> • 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. • 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 | |

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| | <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. 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. | |

Minutes of Meeting held on 21-11-2018

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

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| 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.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. | |

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| | <ul style="list-style-type: none"> 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 vessels to go around the entire site rather than attempting to get through. Radar reflectors / RACONS on all four corners. Consider AIS on all four corners. | |
| 9 | Other | |

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| | <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. | |
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Minutes of Meeting held on 21-11-2018

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

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| 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 Introduction to Marico Marine <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. 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.GFB – questioned when the project install is to occur? GM – installation is planned for 2021 to 2022. Review of preliminary vessel traffic analysis <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 astern to reduce rolling and to avoid lashing and ensure the safety of cargo. | |

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| | <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 MDZs 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 MDZs. | |
| 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. 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. | |

Minutes of Meeting held on 10 December-2018

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 Association Stuart Carruthers (SC)
(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.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. | |

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| | <ul style="list-style-type: none"> 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

Client: Menter Môn
Project: Morlais Tidal Demonstration Zone
Venue: Chamber of Shipping
Date of Meeting: 17 December 2018 at 12:15

Chamber of Shipping (COS) Robert Merrylees (RM)
Fena Boyle (FB)
Marico Marine (MM) David Foster (DF)

| Item | Action item / Notes for the record | Action |
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| 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 starboard IAW the ColReg, it will force them close or into the northern E/W zone. | |

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| | <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 MDZs. • 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. ○ SAR restrictions / access difficulties if surface devices are utilised and a sufficient distance for navigation is not maintained between devices. | |

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| 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

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

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| 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 |
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| 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 safety of navigation is preserved, and Search and Rescue capability is maintained. | |

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| | <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 MDZ. <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 MDZ. | |
| 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). • 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. | |

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| | <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 | |

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| | <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. | |

Email Consultation Minutes

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

Annex F: Recreational Boating Additional Information

*Coastal Atlas AIS - Standard and Log10 Scaling Source: RYA UK Coastal Atlas of
Recreational Boating 2.1 User Guide*

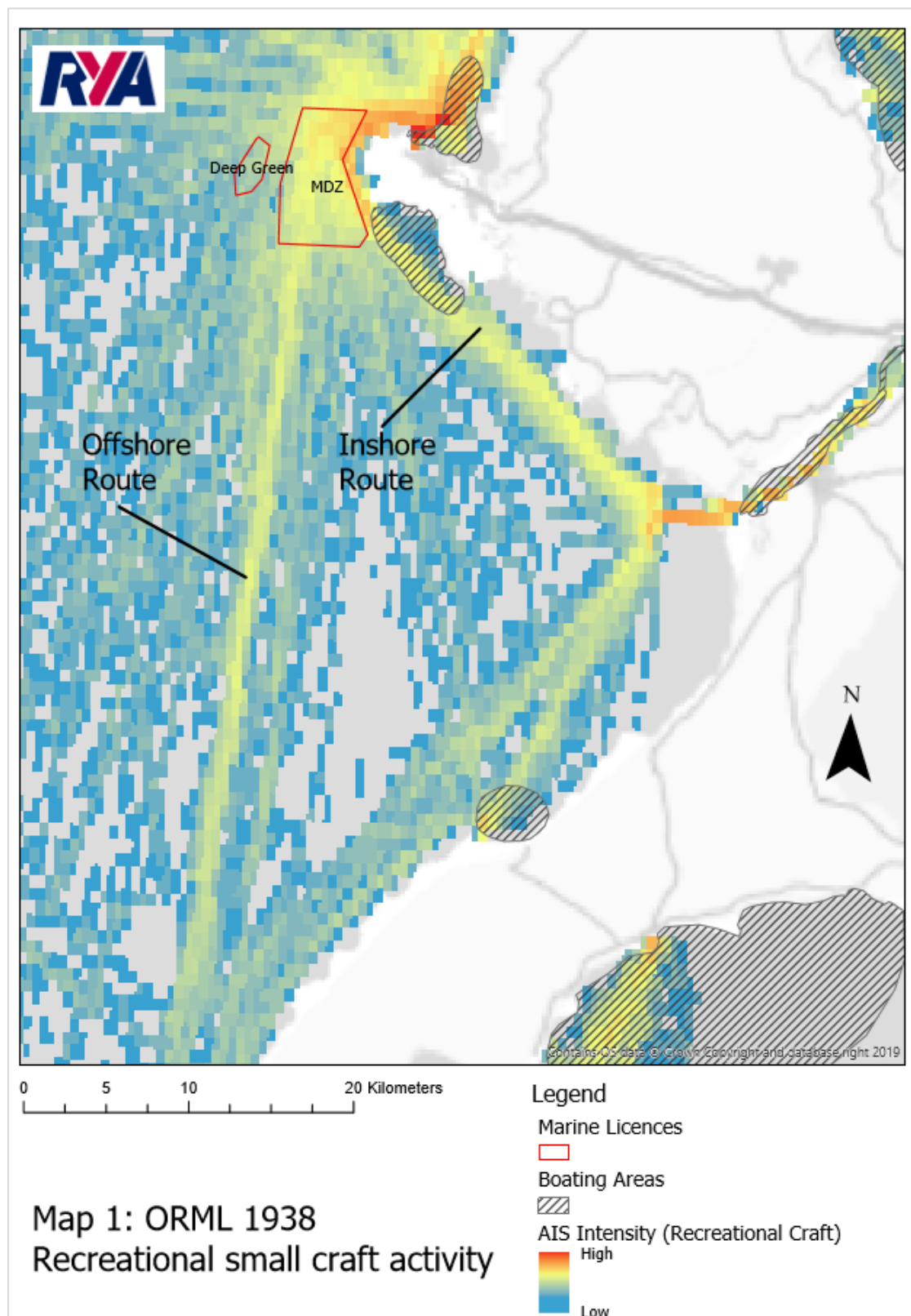


Figure 4 UK AIS with a standard scale



Figure 5 UK AIS with a log₁₀ scale

RYA Recreational Small Craft Activity in Vicinity of MDZ –Log10 AIS– Source RYA March 2020



RYA Passage Planning Guidance

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Have A Plan

Weather & Tides

Overhead Wires

Notices to Mariners

Night Boating

Engine Checks & Preventing Fuel Contamination

Counterfeit Charts & Publications

Lights, Shapes and Sound Signals

Know Your Limits

Look After Yourself

Keep In Touch

Other Resources

Safety Advisories

RYA SafeTRX

RYA Safety Management Policy

Safety Tips & Comments

Emily's Code

Have A Plan

Be prepared; think 'what if?' and don't ruin a good day out on the water with insufficient planning.

An element of planning is required for even the simplest and shortest of journeys. Passage planning is an obligation for all seafarers under the [International Convention on Safety of Life at Sea \(SOLAS V\)](#)

However, a passage plan needn't be complicated. The type of boat you have and the trip you are intending to take will determine how much planning you need to do.

Essential elements to your plan

The plan will consider where you want to go and how you will go about getting there safely.

Route: a straight line from A to B will seldom be possible. Your prior planning will establish your intended route, any hazards or navigational risks that need to be avoided and constraints that may limit your options.

Tides & currents: check the anticipated currents and tidal predictions for your trip and ensure that they fit with what you are planning to do. [Why are tides important?](#)

Navigation dangers: check up-to-date charts and current pilot books, [notices to mariners](#), almanacs or river guides for any navigational dangers such as shoals, overfalls, weirs, overhead wires and buoyage.

Be aware that [counterfeit charts and publications](#) are in circulation and pose a danger to the safety of a vessel and its crews.

Constraints: you also need to plan for the unexpected, which might include deteriorating weather conditions, an illness, injury or gear failure occurring on board, the trip taking longer than expected, missing a tidal gate or simply deciding not to complete the trip.

Refuge: you should look at the charts and pilot book before you leave and consider alternative destinations and places where you could take shelter if necessary.

Daylight: could delays lead to unexpected [night time boating](#)?

Weather: before you go check the weather forecast and get regular updates if you are planning to be out for any length of time. Read more about [weather forecasts](#). Seagoing boats equipped with a VHF radio can monitor Coastguard [maritime safety information](#) broadcasts for updates whilst at sea.

Limitations of the boat: consider whether your boat is up to the proposed trip and that you have the appropriate [safety equipment](#) and stores with you.

Engine: checking your engine before you set off could avoid breaking down when you are underway. [Read more about engine checks.](#)

Crew: take into account the experience and physical ability of your crew. Are they up to the trip you are planning? Are they kitted out with the right personal [safety equipment](#) and have they been briefed on the voyage plan?

A skipper should ensure that everyone on board knows where the safety equipment is stowed and how to use it. Talk them through your plan as well as your contingency plans should something go wrong, including who should take over if you are injured or taken ill. Other aspects are: check that they know how to start the engine, how to send a Mayday and to make them aware of any on board hazards.

Share your plan: let someone onshore know your plan and make sure they understand what to do should they become concerned about your well-being.

Canoe and Kayak UK, PESDA Sea Kayak Route Card -#08- The Stacks.



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PESDA SEA KAYAK ROUTE CARD #08

THE STACKS



PESDA PRESS




The cliffs of Gogarth Bay are popular with rock climbers | Andy Biggs



The Stacks

No. 8 | Grade C | 12km | OS Sheet 114 | Tidal Port Liverpool

Start  Porth Dafarch (233 800)

Finish  Soldiers' Point, Holyhead (236 837)

HW/LW High and low water at Porth Dafarch occur around 1 hour 20 minutes before Liverpool. High and low water at Holyhead are around 48 minutes before Liverpool.

Tidal times At Penrhyn Mawr the NW going stream (flood) starts around 3 hours 30 minutes after HW Liverpool, the SE going stream (ebb) starts around 1 hour 15 minutes before HW Liverpool. At South Stack the NNE going stream (flood) starts around 4 hours 50 minutes after HW Liverpool, the SSW going stream (ebb) starts around 1 hour 10 minutes before HW Liverpool. At North Stack the NE going stream (flood) starts around 5 hours after HW Liverpool, the SW going stream (ebb) starts 2 hours before HW Liverpool.

Tidal rates This area has a reputation for fast tidal streams, which can exceed 6 knots on spring tides.

Coastguard Holyhead, Tel. 01407 762051, VHF Weather 0235 UT.

INTRODUCTION Having negotiated the jagged headland and associated overfalls of Penrhyn Mawr you will be committed for the rest of this awe-inspiring journey around South and North Stack.

DESCRIPTION The narrow rocky bay at Porth Dafarch makes an ideal place to launch soon after the flood stream begins and you will arrive at Penrhyn Mawr in plenty of time to watch the overfalls build. Porth Ruffydd has a small pebbly beach. It is possible to land here and walk the short distance to the headland, if you feel the need to check the mood of the sea before reaching the waves and whirlpools of Penrhyn Mawr. As you emerge from the overfalls South Stack and the lighthouse appear but are still over 2km away. The route to South Stack from here is a matter of choice. The quick way is to stay offshore. Follow the tidal stream flowing north-west, then north, giving swift passage through more overfalls at South Stack. The slower, more interesting route is to stay close inshore. Abraham's Bosom is the rocky bay to the north of Penrhyn Mawr. It is possible to land on a pebbly beach here and escape to the coast road above the cliffs. But to carry a kayak up the steps is very difficult. South Stack, or Ynys Lawd, is a small island separated less than 3m from the mainland. This is the most westerly point of Holy Island. South Stack and the cliffs nearby are important seabird colonies and should be given a wide berth during the breeding season (May to August). With South Stack behind you, Gogarth Bay opens up ahead. The cliffs here are popular with climbers. There are further caves and gullies on toward North Stack that are perfect for the inquisitive paddler but be aware of dangerous waves created by car ferries from Holyhead Harbour. The overfalls that develop at North Stack during the middle of the SW going ebb are just as spectacular as those at Penrhyn Mawr on the flood. The crux of this trip is to arrive at North Stack before the tide turns here. The final landing is little more than 1km beyond Ynys Wellt. Waves breaking on the reef here often catch out paddlers and the pebbly beach at Soldiers' Point is steep and landing can be awkward. The track leading to the breakwater is privately owned, but frequently used without objection, however there is a public car park a short walk away at the Holyhead Breakwater Country Park.

TIDE & WEATHER A large eddy forms during both flood and ebb within Abraham's Bosom. Although the races at North and South Stack are not far, the strength of the tide is not felt within Gogarth Bay. Anything more than a gentle breeze from the south, west or north has a significant effect on the tidal races. Wind against tide can produce huge breaking seas that are, for mortals, better observed from land.



Excerpt abridged and adapted from *Welsh Sea Kayaking* by Andy Biggs & Jim Krawiec. ISBN 0954706188, published by Pesda Press, Caernarfon. For details of this and other books, as well as downloads of further mini-guides and route cards in this series, visit: WWW.PESDAPRESS.COM



canoe-kayak

Imray C52 Admiralty 1413 – Anglesey – Holyhead Bay

3.5 Anglesey – Holyhead Bay

Imray C52, Admiralty 1413, 1977, 2011, SC5609

Adjust WGS84 for OSGB: 0'01S, 0'08E

Coastguard: Holyhead MRSC 01407 762051

3.5.1 Sailing Directions

GENERAL DIRECTIONS

Holyhead Bay extends some 6 miles from North Stack in the southwest, to Carmel Head, in the northeast and has a depth from this chord, southeastward to Beddmanarch Bay, of 4 miles. The bay is almost free from shoals and, except for the Langdon Ridge, the only dangers lie close inshore on its southeastern shores, the more important of which are marked by buoys. Langdon Ridge lies 2 miles west-southwest from Carmel Head, and has a least depth of 13 metres. Severe overfalls frequently occur in the vicinity. The southern shore of Holyhead Bay is largely occupied by the harbour of Holyhead, the only harbour on the North Wales and Anglesey coasts which is accessible in all weathers and at all states of the tide.

The tidal race off South Stack has been described in Section 3.4.4, and turning the corner into Holyhead Bay can be expected to give immediate relief in southwesterlies. However, any wind with north in it can cause big seas along this entire stretch and sixty

foot seas have been reported 5 miles NW of North Stack in storm conditions.

The area around Carmel Head and the Skerries should be treated with special caution since not only do several tides meet, but the seabed is very uneven, giving rise to overfalls. In 'normal' conditions, the area is totally safe for vessels drawing less than 3 m of water, and SE of the line joining North Stack to Carmel Head, wave height and steepness decrease rapidly as tidal rates drop. It is often possible to day sail in Holyhead Bay when a passage would be inadvisable or impossible.

Southerly winds cause fewer problems, with only normal overfalls off the Head and steeper seas in Church Bay. Timing a passage for LW slack dissipates many of these problems.

Crossing from North Stack to Carmel Head, presents another particularly lumpy stretch of water which may be avoided by shaping a course into Church Bay, towards the *Bolivar* (G con) buoy and, when it is sighted, turning north for Carmel Head.

3.4.3 Passage making

Most passages will start in the Menai Strait which is covered in Section 3.3.3. However, there are times, in settled weather, when a passage may be planned from Llanddwyn Island.

North bound from Caernarfon Bar or Llanddwyn Island, the trip should be timed to arrive at South Stack at LW slack (Dover LW), carrying an adverse tide of between ½ knot and 1 knot along the coast – slackest about 3 miles offshore.

In addition, tide races off the headlands and offlying rocky outcrops – in particular Maen Piscar (dries 1.7m), NW of Rhoscolyn Head – makes a track at least 2 miles offshore a reasonable option.

In wind over tide, and Spring tide conditions, overfalls develop on underwater spurs between Rhosneigr and Trearddur Bay, and a passage 3 miles offshore along this stretch of coast is needed to avoid them. The overfalls are seldom dangerous in winds of less than Force 5.

The Stacks

South Stack offers an area of particularly confused seas (see 4.2.4) and in heavy conditions an offing of 7 miles is needed to

avoid overfalls and tide races. Northwest of the Stacks, the sharp escarpment into Holyhead Deep can produce some character forming seas at the strength of the tide, irrespective of wind conditions.

Passages southbound from Llanddwyn Island to Bardsey Sound should be planned to reach Braich-y-Pwll at HW slack (HW Dover –0100). Late arrival at the Sound will usually result in some hours of practising 'sailing on the spot' – or even sailing backwards! For destinations further south, including Eire, full advantage should be taken of the ebb by leaving Llanddwyn at local HW (HW Dover –0130).

Southbound past the Stacks, North Stack is best passed about ½ hour before HW or, alternatively, soon after half ebb, when the race has begun to ease off.

In the event that there is any sign of a tide race off either Stack, it may be advantageous to stand in close to the cliffs and cut through the race as near as possible to the rocks.

It may be dangerous to attempt passage round the Stacks, in either direction, in any sort of wind over tide conditions or with winds of Force 5 or greater.

3.4.4 Tides

OFFSHORE

The tide floods northerly up the Irish Sea and divides in the region of Bardsey Island, one branch running directly to Holyhead. At South Stack, it again divides, the main stream travelling north and east to Liverpool Bay, the other diverted south down the Anglesey coast. The branch of the main stream, travelling north east up the coast of the Lleyn Peninsula enters the Menai Strait over Caernarfon Bar and proceeds northwest to collide with the south going stream from South Stack. At the strength of the flood, overfalls, eddies and whirlpools may develop in and around Penrhos Bay and Abrahams Bosom.

Offshore tidal streams are generally less than 1 knot but overfalls and races off headlands and over outlying rocks considerably increase streams locally.

The effects are particularly noticeable off Rhoscolyn, South Stack and over Holyhead Deep.

North of Rhoscolyn, tidal streams increase rapidly, and the run across Trearddur Bay, round Penrhyn Mawr to South Stack will usually have to be made against a strong adverse tide if a generally favourable tide is to be carried from South Stack to Holyhead. Tide races exist at all the headlands, those at Rhoscolyn Head and Penrhyn Mawr being confined to within 1 mile of the coast. Both can create dangerous seas with onshore winds.

CAERNARFON BAR

Over the 3 miles of the Bar, the tidal rate decreases from 5 knots (Springs) in Belan Narrows to less than 1 knot at C1 (see Tidal Atlas, Section 2). On both flood and ebb, the flow sets strongly across the banks. HW coincides with slack water at approx. HW (Dover) -0145.

The combination of tides appears to result in a rapid increase in depth at around local LW +0200, followed by a stand until the last hour of the flood. It may be that the range on

half of the flood, a local eddy develops in the southeast corner of Penrhos Bay.

On the ebb, the tide makes a broad sweep of the bay before setting strongly off Rhoscolyn Head to form a rip tide. Thereafter, a large, circular, anticlockwise movement is induced, which spreads as far south as Rhoscolyn. As a result, in Penrhos Bay, the inshore stream starts to run westward shortly after half ebb and starts to run northwest off Ravenspoint about two hours before LW in Trearddur Bay.

During the strength of the flood, the stream runs at 5 knots (springs) past Penrhos Point, forming a tide race and heavy overfalls over the offlying rocks. In the Inshore passage, it flows in a westerly direction with a heavy rippling movement from Tide-rip Rock to a point about ½ mile off Penrhos Point.

During the ebb, the stream is much weaker due to its offset by South Stack. A inshore eddy develops in the first two hours of the ebb in the lee of South Stack, slowly extending over the whole of Penrhos Bay as the ebb develops. This results in the stream at Tide-rip Rock turning to the northwest about 2 hours before LW.

THE STACKS

The race at South Stack reaches 6 knots and can, in suitable conditions, create a confused steep sea with 2 metre breakers in wind strengths of Force 3.

Full tidal velocity is reached about 1½ hours after slack on both flood and ebb. (HW (Dover) +0020, -0445) On the flood, the race begins to ease at 4½ hrs after LW slack (HW (Dover) -0145): on the ebb, it eases approximately 3½ hrs after HW slack (HW (Dover) +0240). The race extends for 7 miles in strong winds (Force 7+) and Spring tides.

Tides, and tidal effects, slacken rapidly once North Stack is rounded into Holyhead Bay.

The main tidal streams off the Stacks set northeast with the flood and southwest with the ebb. The times of the change of direction of the stream coincide with the times of high and low water in the area, that is, 8 minutes before high and low water at Holyhead. (HW (Dover) -0045). Owing to the strength of the stream and the unevenness of the seabed in this locality, patches of overfalls occur within an area extending about 1½ miles northwestward from the Stacks. Inshore, tide-races run off the points of the Stacks at a rate of about 6 knots at springs and 3 knots at neaps, causing a steep, confused and breaking sea, especially when wind and tide are opposed.

Tidal streams in Gigorth Bay are weak, but during the strength of the tides eddy streams are set up in the lee of South Stack by the flood, and in the lee of North Stack by the ebb.

Once the flood stream has set in off the Stacks its velocity increases until, at about 1 hours of flood, it is running at full strength. The strong offset of the stream from the South Stack causes a tide-race, particularly violent over the 20 metre spur extending about 4

cables northwest, to run in a wide north-westerly arc for the next 3hr, at the end of which time it eases down perceptibly. A tide-rip is formed close northwestward of North Stack during the last hour of the flood tide. During the flood tide local eddy streams are formed in Gigorth Bay, and close inshore from Porth Namarch to close eastward of the point below North Stack Fog Signal Station.

During the ebb, the strong offset of the stream from North Stack causes a tide-race to extend in a wide westerly arc to a position close westward of South Stack until about 3 hours after HW. During the ebb tide, local eddy streams are formed in Gigorth Bay and in the lee of South Stack.

3.4.5 Harbours and Anchorages

The format used to describe harbours and anchorages throughout this Guide is based on a combination of sources, not all of which are consistent.

*Hence, **chartlets must not be used for navigation** (see Section 1.2 for more details).*

This is a coast for testing anchoring technique, including deploying an anchor buoy if you go to Rhosneigr or Trearddur Bay. There are occasional moorings in other bays, but most of the vessels laying moorings (all private and of questionable provenance) are small (less

than 25ft) fishing boats. Abandoned tackle may be found anywhere.

In this section the following anchorages are covered:

- Llanddwyn Island
- Pen-y-Parc
- Porth Tre Castell
- Rhosneigr
- Silver Bay
- Rhoscolyn
- Trearddur Bay

Annex G MGN 543 Checklist

MGN 543 (M+F) Safety of Navigation: Offshore Renewable Energy Installations –

Guidance on UK Navigational Practice, Safety and Emergency Response

| Issue: OREI Response | Yes/No | Comments |
|--|--------|--|
| Annex 1: Considerations on Site Position, Structures and Safety Zones | | |
| <p>1. Site and Installation Co-ordinates: Developers are responsible for ensuring that formally agreed co-ordinates and subsequent variations of site perimeters and individual OREI structures are made available, on request, to interested parties at relevant project stages, including application for consent, development, array variation, operation and decommissioning. This should be supplied as authoritative Geographical Information System (GIS) data, preferably in Environmental Systems Research Institute (ESRI) format. Metadata should facilitate the identification of the data creator, its date and purpose, and the geodetic datum used. For mariners' use, appropriate data should also be provided with latitude and longitude coordinates in WGS84 (ETRS89) datum.</p> | | |
| Traffic Survey – includes: | | |
| All vessel types | ✓ | Vessel traffic analysis is contained in Section 7 . All vessel types were considered. |
| At least 28 days duration, within either 12 or 24 months prior to submission of the Environmental Statement | ✓ | Details of the vessel traffic data are contained in Section 7.1.4 . 28 days of combined RADAR and AIS was utilised in addition to 6 months of additional AIS data. All data utilised is within 24 months validity period. |
| Multiple data sources | ✓ | Details of the vessel traffic data are contained in Section 6 and include AIS, RADAR and secondary sources. |
| Seasonal variations | ✓ | Details of the vessel traffic data are contained in Section 7.1.4 . Datasets cover summer and winter periods. |
| MCA consultation | ✓ | The MCA was consulted and details are contained in Section 6.2, Annex D and Annex E . |
| General Lighthouse Authority consultation | ✓ | Trinity House was consulted and details are contained in Section 6.2, Annex D and Annex E . |
| Chamber of Shipping consultation | ✓ | The Chamber of Shipping was consulted and details are contained in Section 6.2 and Annex D and Annex E . |
| Recreational and fishing vessel organisations consultation. | ✓ | The RYA and local recreational and fishing representatives were consulted and details are contained in Section 6.2, Annex D and Annex E . |
| Port and navigation authorities consultation, as appropriate | ✓ | The Holyhead Harbour Master was consulted and details are contained in Section 6.2, Annex D and |

| | | |
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| | | Annex E. The MDZ is approximately 2 miles from the nearest SHA area. |
| Assessment of the cumulative and individual effects of (as appropriate): | | |
| i. Proposed OREI site relative to areas used by any type of marine craft. | ✓ | Vessel traffic analysis of all vessel types is contained in Section 7 . Other marine uses identified in Section 4 . |
| ii. Numbers, types and sizes of vessels presently using such areas | ✓ | Vessel traffic analysis of all vessel types is contained in Section 7 . |
| iii. Non-transit uses of the areas, e.g. fishing, day cruising of leisure craft, racing, aggregate dredging, etc. | ✓ | Vessel traffic analysis of all vessel types is contained in Section 7 . Other marine uses identified in Section 4 . |
| iv. Whether these areas contain transit routes used by coastal or deep-draught vessels on passage. | ✓ | Vessel traffic analysis of all vessel types is contained in Section 7 . Analysis of vessels by draught is contained in Section 9 . |
| v. Alignment and proximity of the site relative to adjacent shipping lanes | ✓ | Section 7 assesses shipping in vicinity of the site. Section 4.4 discusses locations of nearby routeing schemes. Note: commercial shipping activity is low in the vicinity of the study area with exception of the ferry route to the north. |
| vi. Whether the nearby area contains prescribed routeing schemes or precautionary areas | ✓ | Section 4.4 discusses locations of nearby routeing schemes. |
| vii. Whether the site lies on or near a prescribed or conventionally accepted separation zone between two opposing routes. | ✓ | Section 4.4 discusses locations of nearby routeing schemes. |
| viii. Proximity of the site to areas used for anchorage, safe haven, port approaches and pilot boarding or landing areas. | ✓ | The baseline marine environment including proximity of anchorages, shelter and pilot boarding areas are described within Section 4 . The MDZ is approximately 2 miles from the nearest SHA area. |
| ix. Whether the site lies within the jurisdiction of a port and/or navigation authority. | ✓ | The site is outside of Holyhead Port limits. |

| | | |
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| x. Proximity of the site to existing fishing grounds, or to routes used by fishing vessels to such grounds. | ✓ | Analysis of fishing vessel activity is contained in Section 7 . |
| xi. Proximity of the site to offshore firing/bombing ranges and areas used for any marine military purposes. | ✓ | There are no PEXA areas near the site (Section 4.13). |
| xii. Proximity of the site to existing or proposed offshore oil / gas platform, marine aggregate dredging, marine archaeological sites or wrecks, Marine Protected Area or other exploration/exploitation sites. | ✓ | Section 4 identifies other offshore activities near the site. |
| xiii. Proximity of the site to existing or proposed OREI developments, in co-operation with other relevant developers, within each round of lease awards. | ✓ | Section 4.8 identifies other OREI's near the site. |
| xiv. Proximity of the site relative to any designated areas for the disposal of dredging spoil or other dumping ground | ✓ | Section 4.11 identifies dredge disposal site near the project. |
| xv. Proximity of the site to aids to navigation and/or Vessel Traffic Services (VTS) in or adjacent to the area and any impact thereon. | ✓ | The site is outside the port limits of the Port of Holyhead and there is no VTS coverage of the site. Principle marks are identified within Section 4 and in consultation with Trinity House in Annex D and Annex E . |
| xvi. Researched opinion using computer simulation techniques with respect to the displacement of traffic and, in particular, the creation of 'choke points' in areas of high traffic density and nearby or consented OREI sites not yet constructed. | ✓ | The displacement of traffic and choke points are discussed and assessed within Section 7 , Annex B and Annex C . The primary choke point is considered to be the inshore passage in the vicinity of South Stack lighthouse. |
| xvii. With reference to xvi. above, the number and type of incidents to vessels | ✓ | Section 8 analyses historical incidents near the site using MAIB data. |

| | | |
|---|-------|---|
| which have taken place in or near to the proposed site of the OREI to assess the likelihood of such events in the future and the potential impact of such a situation. | | |
| 3. OREI Structures – the following should be determined: | | |
| a. Whether any feature of the OREI, including auxiliary platforms outside the main generator site, mooring and anchoring systems, 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. | ✓ | <p>The impact of the site on vessel contacts is assessed in Section 9, Section 12, Annex B and Annex C.</p> <p>Snagging / Obstruction identified as a hazard and assessed in Section 9, Section 12, Annex B and Annex C.</p> <p>A number of suggested mitigation measures to reduce the risk of contact and snagging / obstruction have been identified in Section 13.</p> <p>To be assessed further as part of device / array specific assessments once a site layout is further defined.</p> |
| b. Clearances of wind turbine blades above the sea surface are <i>not less than 22 metres</i> above MHWS. | | N/A |
| c. Underwater devices <ul style="list-style-type: none"> i. changes to charted depth ii. maximum height above seabed iii. Under Keel Clearance | ✓ | <p>Section 10 provides analysis of the impact on UKC.</p> <p>The height above seabed depends on selection of device and charted depth and should be assessed on a case by case basis for each device within Device Specific Navigation Risk Assessments.</p> |
| d. The burial depth of cabling and changes to charted depths associated with any protection measures. | ✗ / ✓ | <p>The cables are likely to be unburied and protected (Section 2.2). A high-level discussion on cable impacts has been undertaken within Section 14.</p> <p>Requirement for the MDZ area to be surveyed and charted as required by UKHO embedded in project (Section 11.4).</p> <p>More detailed assessment of changes to charted depths to be undertaken once the cable route has been determined.</p> |

4. Assessment of Access to and Navigation Within, or Close to, an OREI to determine the extent to which navigation would be feasible within the OREI site itself by assessing whether:

a. Navigation within or close to the site would be safe:

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| <ul style="list-style-type: none"> i. by all vessels, or ii. by specified vessel types, operations and/or sizes. iii. in all directions or areas, or iv. in specified directions or areas. v. in specified tidal, weather or other conditions | ✓ | <p>Sections 11, 12 and 13 assess the impact to all vessel types and suggest mitigation measures aimed at further reducing the identified risks for those hazards scoring ALARP or higher (See also Annex B and Annex C).</p> <p>Section 4.1 discusses baseline metocean conditions.</p> <p>Section 9 discusses impacts of the MDZ on metocean conditions.</p> |
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b. Navigation in and/or near the site should be:

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| <ul style="list-style-type: none"> i. prohibited by specified vessels types, operations and/or sizes. ii. prohibited in respect of specific activities, iii. prohibited in all areas or directions, or iv. prohibited in specified areas or directions, or v. prohibited in specified tidal or weather conditions, or simply recommended to be avoided. vi. | ✓ | <p>Sections 11, 12 and 13 assess the impact to all vessel types and suggest mitigation measures aimed at further reducing the identified risks for those hazards scoring ALARP or higher (See also Annex B and Annex C).</p> <p>Section 4.1 discusses baseline metocean conditions.</p> <p>Section 9 discusses impacts of the MDZ on metocean conditions.</p> <p>Mitigation measures 'Restrict Navigation through the gold and green MDZ zones' and 'MDZ designation as no fishing zone' suggested for consideration Section 13.</p> |
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c. Exclusion from the site could cause navigational, safety or routing problems for vessels operating in the area e.g. by preventing vessels from responding to calls for assistance from persons in distress.

✓

Requirement to Formulate and implement an Emergency Response Co-operation Plan (ERCOP) embedded in project (**Section 11.4**). See SAR below.

Section 13 discusses suggested additional risk control measures. 'Restrict Navigation through the gold and green MDZ zones' and 'MDZ designation as no fishing zone' suggested for consideration **Section 13**.

Relevant information concerning a decision to seek a safety zone for a particular site during any point in its construction, extension, operation or

✓ /
N/A

Section 13 discusses suggested risk control options, including 'Implementation of safety zones' of appropriate configuration, extent and application.

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| decommissioning should be specified in the Environmental Statement accompanying the development application | | |
| Annex 2: Navigation, collision avoidance and communications | | |
| 1. The Effect of Tides and Tidal Streams : It should be determined whether: | | |
| a. Current maritime traffic flows and operations in the general area are affected by the depth of water in which the proposed installation is situated at various states of the tide i.e. whether the installation could pose problems at high water which do not exist at low water conditions, and vice versa. | ✓ | Section 4.1 discusses baseline metocean conditions in vicinity of the MDZ. Section 9 discusses impacts of the MDZ on metocean conditions. The impact upon UKC is addressed within Section 10 . UKC should be assessed on a case by case basis within device specific assessments one devices to be installed in each area are known. |
| b. The set and rate of the tidal stream, at any state of the tide, has a significant effect on vessels in the area of the OREI site. | ✓ | Section 4.1 discusses metocean conditions. Section 9 discusses impacts of the MDZ on metocean conditions. |
| c. The maximum rate tidal stream runs parallel to the major axis of the proposed site layout, and, if so, its effect. | ✓ | Section 4.1 discusses metocean conditions. Section 9 discusses impacts of the MDZ on metocean conditions. |
| d. The set is across the major axis of the layout at any time, and, if so, at what rate. | ✓ | Section 4.1 discusses metocean conditions. Section 9 discusses impacts of the MDZ on metocean conditions. |
| e. In general, whether engine failure or other circumstance could cause vessels to be set into danger by the tidal stream. | ✓ | Section 4.1 discusses metocean conditions. Section 9 discusses impacts of the MDZ on metocean conditions. Section 12, Annex B and Annex C consider the risk of a vessel contacting the device including as a result of being set on to devices by the tidal stream. |
| f. The structures themselves could cause changes in the set and rate of the tidal stream. | ✓ | Section 9 discusses impacts of the MDZ on metocean conditions. |

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| g. The structures in the tidal stream could be such as to produce siltation, deposition of sediment or scouring, affecting navigable water depths in the OREI or adjacent to the area | ✓ | Section 9 discusses impacts of the MDZ on metocean conditions. |
| 2. Weather: It should be determined whether: | | |
| a. The site, in normal, bad weather, or restricted visibility conditions, could present difficulties or dangers to craft, including sailing vessels, which might pass in close proximity to it. | ✓ | Section 12, Annex B and Annex C consider the risk of a vessel contacting the devices. Section 4.1 discusses metocean conditions. Section 9 discusses impacts of the MDZ on metocean conditions. |
| b. The structures could create problems in the area for vessels under sail, such as wind masking, turbulence or sheer. | ✓ | Section 4.1 discusses MetOcean conditions. Section 9 discusses impacts of the MDZ on metocean conditions. Not considered significant for the proposed device types. |
| c. In general, taking into account the prevailing winds for the area, whether engine failure or other circumstances could cause vessels to drift into danger, particularly if in conjunction with a tidal set such as referred to above. | ✓ | Section 12, Annex B and Annex C consider the risk of a vessel contacting the device. Section 4.1 discusses metocean conditions. Section 9 discusses impacts of the MDZ on metocean conditions including as a result of being set on to devices by the tidal stream. |
| 3. Collision Avoidance and Visual Navigation: It should be determined whether: | | |
| a. The layout design will allow safe transit through the OREI by SAR helicopters and vessels. | ✓ | Requirement for the 'Formulation and implementation of an Emergency Response Co-operation Plan (ERCoP) Embedded in project (Section 11.4). Mitigation measures aimed at ensuring safe transit by SAR suggested in Section 13 including 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' and the potential impacts the proposed location may have on navigation and SAR activities. The impact to helicopters is not considered to be significant. |
| b. The MCA's Navigation Safety Branch and Maritime Operations branch will be | ✓ | Consultation with MCA on proposed MDZ presented within Section 6.2, Annex D and Annex E. Section 13 |

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| consulted on the layout design and agreement will be sought. | | sets out recommendation / requirement for MCA to be consulted on device specific layout. |
| c. The layout design has been or will be determined with due regard to safety of navigation and Search and Rescue. | ✓ | Requirement for the 'Formulation and implementation of an Emergency Response Co-operation Plan (ERCoP) embedded in project (Section 11.4). Mitigation measures aimed at ensuring safe transit by SAR suggested in Section 13 including 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' and the potential impacts the proposed location may have on navigation and SAR activities. |
| d.i. The structures could block or hinder the view of other vessels under way on any route. | ✓ | Not considered significant given the scale of the devices. |
| d.ii. The structures could block or hinder the view of the coastline or of any other navigational feature such as aids to navigation, landmarks, promontories, etc. | ✓ | Obstruction of view not considered significant given the scale of the devices. Primary mark is South Stack lighthouse (Section 4.6). The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4). |
| 4. Communications, Radar and Positioning Systems - To provide researched opinion of a generic and, where appropriate, site specific nature concerning whether: | | |
| a. The structures could produce radio interference such as shadowing, reflections or phase changes, and emissions with respect to any frequencies used for marine positioning, navigation and timing (PNT) or communications, including GMDSS and AIS, whether ship borne, ashore or fitted to any of the proposed structures, to: i. Vessels operating at a safe navigational distance | ✓ | Section 5 reviews the possible impacts on ship communications, radar and position systems. Given the scale of the devices this is not considered to be significant. |

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| <p>ii. Vessels by the nature of their work necessarily operating at less than the safe navigational distance to the OREI, e.g. support vessels, survey vessels, SAR assets.</p> <p>iii. Vessels by the nature of their work necessarily operating within the OREI.</p> | | |
| <p>b. The structures could produce radar reflections, blind spots, shadow areas or other adverse effects:</p> <p>i. Vessel to vessel;</p> <p>ii. Vessel to shore;</p> <p>iii. VTS radar to vessel;</p> <p>iv. Racon to/from vessel.</p> | ✓ | <p>Section 5 reviews the possible impacts on ship communications, radar and position systems. Given the scale of the devices this is not considered to be significant.</p> |
| <p>c. The structures and generators might produce sonar interference affecting fishing, industrial or military systems used in the area.</p> | ✗ | <p>Considered within other relevant chapters within the ES. To be considered within device specific risk assessments.</p> |
| <p>d. The site might produce acoustic noise which could mask prescribed sound signals.</p> | ✗ | <p>Considered within other relevant chapters within the ES. To be considered within device specific risk assessments.</p> |
| <p>e. Generators and the seabed cabling within the site and onshore might produce electro-magnetic fields affecting compasses and other navigation systems.</p> | ✗ | <p>If found to be significant a warning note should be added to the Admiralty chart. To be assessed once cable route is known.</p> |
| <p>5. Marine Navigational Marking: It should be determined:</p> | | |
| <p>a. How the overall site would be marked by day and by night throughout construction, operation and decommissioning phases, taking into account that there may be an ongoing requirement for marking on completion</p> | ✗ | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |

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| of decommissioning, depending on individual circumstances. | | |
| b. How individual structures on the perimeter of and within the site, both above and below the sea surface, would be marked by day and by night. | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |
| c. If the specific OREI structure would be inherently radar conspicuous from all seaward directions (and for SAR and maritime surveillance aviation purposes) or would require passive enhancers. | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> |
| d. If the site would be marked by additional electronic means e.g. Racons | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |
| e. If the site would be marked by an AIS transceiver, and if so, the data it would transmit. | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |
| f. If the site would be fitted with audible hazard warning in accordance with IALA recommendations | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |
| g. If the structure(s) would be fitted with aviation lighting, and if so, how | N/A | N/A Impact to helicopters not considered significant given scale of devices. |

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| these would be screened from mariners or guarded against potential confusion with other navigational marks and lights. | | |
| h. Whether the proposed site and/or its individual generators complies in general with markings for such structures, as required by the relevant GLA in consideration of IALA guidelines and recommendations. | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |
| i. The aids to navigation specified by the GLAs are being maintained such that the 'availability criteria', as laid down and applied by the GLAs, is met at all times. | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |
| j. The procedures that need to be put in place to respond to casualties to the aids to navigation specified by the GLA, within the timescales laid down and specified by the GLA. | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |
| k. The ID marking will conform to a spreadsheet layout, sequential, aligned with SAR lanes and avoid the letters O and I. | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |
| l. Working lights will not interfere with AtoN or create confusion for the Mariner navigating in or near the OREI. | x | <p>Marking and lighting not assessed. The requirement for the site to be 'marked in accordance with Trinity House' is embedded in the project (Section 11.4).</p> <p>Additional mitigation 'Undertaking device / array specific risk assessments to include NavAids and Marker Buoys' suggested in Section 13.</p> |

6. Hydrography - In order to establish a baseline, confirm the safe navigable depth, monitor seabed mobility and to identify underwater hazards, detailed and accurate hydrographic surveys are included or acknowledged for the following stages and to MCA specifications:

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| i. Pre-consent: The site and its immediate environs extending to 500m outside of the development area shall be undertaken as part of the licence and/or consent application. The survey shall include all proposed cable route(s). | ✓ | Requirement for site to be 'surveyed and charted as required by UKHO' embedded in the project (Section 11.4). |
| ii. Post-construction: Cable route(s) | ✓ | Requirement for site to be 'surveyed and charted as required by UKHO' embedded in the project (Section 11.4). |
| iii. Post-decommissioning of all or part of the development: Cable route(s) and the area extending to 500m from the installed generating assets area. | ✓ | Requirement for site to be 'surveyed and charted as required by UKHO' embedded in the project (Section 11.4). |

Annex 3: MCA template for assessing distances between OREI boundaries and shipping routes

"Shipping Route" template and Interactive Boundaries – where appropriate, the following should be determined:

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| a. The safe distance between a shipping route and turbine boundaries. | ✓ | Section 7, Section 12, Annex B and Annex C consider the impact on vessel routeing. The ferry route and inshore passage were identified to be the primary routes in vicinity of the MDZ. A separate Interactive Boundary assessment of both routes was completed in line with MGN 543 Annex 3 requirements ³² . |
| b. The width of a corridor between sites or OREIs to allow safe passage of shipping. | ✓ | Section 7, Section 12, Annex B and Annex C consider the impact on vessel routeing. The ferry route and inshore passage were identified to be the primary routes in vicinity of the MDZ. A separate Interactive |

³² 20UK1619_RN_MM_VTS02-02

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| | | Boundary assessment of both routes was completed in line with MGN 543 Annex 3 requirements ³³ . |
| Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning. | | |
| Mitigation and safety measures will be applied to the OREI development appropriate to the level and type of risk determined during the EIA. The specific measures to be employed will be selected in consultation with the Maritime and Coastguard Agency and will be listed in the developer's Environmental Statement (ES). These will be consistent with international standards contained in, for example, the SOLAS Convention - Chapter V, IMO Resolution A.572 (14) ³ and Resolution A.671(16) ⁴ and could include any or all of the following: | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| i. Promulgation of information and warnings through notices to mariners and other appropriate maritime safety information (MSI) dissemination methods. | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| ii. Continuous watch by multi-channel VHF, including Digital Selective Calling (DSC). | | |
| iii. Safety zones of appropriate configuration, extent and application to specified vessels ³⁴ | | |

³³ 20UK1619_RN_MM_VTS02-02

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| iv. Designation of the site as an area to be avoided (ATBA). | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| v. Provision of AtoN as determined by the GLA | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| vi. Implementation of routing measures within or near to the development. | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| vii. Monitoring by radar, AIS, CCTV or other agreed means | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| viii. Appropriate means for OREI operators to notify, and provide evidence of, the infringement of safety zones. | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| ix. Creation of an Emergency Response Cooperation Plan with the MCA's Search and Rescue Branch for the construction phase onwards. | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| x. Use of guard vessels, where appropriate | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| xi. Any other measures and procedures considered appropriate in consultation with other stakeholders. | ✓ | Section 11.4 and Section 13 list the embedded and suggested additional mitigation measures considered within the NRA Addendum. |
| Annex 5: Standards, procedures and operational requirements in the event of search and rescue, maritime assistance service counter pollution or salvage incident in or around an OREI, including generator/installation control and shutdown. | | |
| The MCA, through HM Coastguard, is required to provide SAR and emergency response within the sea area occupied by all offshore renewable energy installations in UK waters. To ensure that such operations can be safely and effectively conducted, certain requirements must be met by developers and operators. | | |

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| a. An ERCoP will be developed for the construction, operation and decommissioning phases of the OREI. | ✓ | Section 11.4 lists embedded mitigation measures including the requirement for the ‘Formulation and implementation of an Emergency Response Co-operation Plan (ERCoP)’. |
| b. The MCA’s guidance document <i>Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency Response</i> for the design, equipment and operation requirements will be followed. | ✓ | Formulation and implementation of an Emergency Response Co-operation Plan (ERCoP) in line with ‘Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency’ document embedded in project (Section 11.4). Mitigation measure ‘appropriate alignment and spacing of arrays and devices’ suggested inline with ‘Offshore Renewable Energy Installation: Requirements, Advice and Guidance for Search and Rescue and Emergency’ requirements (Section 13). |